# AMATEUR WORK

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## BURGLAR ALARM FITTING.

ROBERT N. STAPLES.

It is commonly supposed that burglar alarms are expensive to install, are complicated in construction, and require a considerable amount of electrical experience to maintain. Nothing could be more erroneous. Anyone who will carefully follow these directions may install alarms, and accomplish absolutely perfect results. Burglar alarms are suited for doors, windows and bulkheads of houses and workshops. and suitable apparatus may also be connected with gates, stairways, doormats and carpets, with wiring so concealed that it cannot be tampered with. By the aid of the following descriptions and diagrams, installations may be successfully made with very few tools.

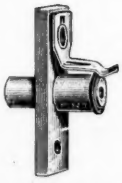


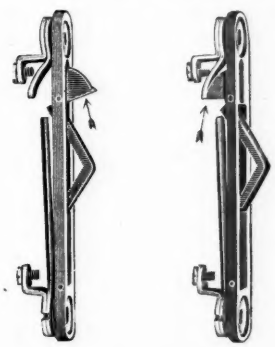
FIG. 1. OPEN CIRCUIT DOOR SPRING.

FIG. 2. CLOSED CIRCUIT DOOR SPRING.

Fig. 1 represents a type of open circuit door spring. This device is fitted in the framework of the door jamb, near the upper hinge, by boring a half-inch hole into the jamb. This device is just the reverse of a push button; that is, a push button, when pressed, connects two contact springs and completes the circuit through battery and bell. In the door spring the closed door keeps the button pressed way in, and the contact is only closed when the opening door permits the press knob to come out. In this device a door left open leaves the alarm in continuous circuit, so another device having a wide contact, or make and break device, Fig. 2, is designed to close the circuit through the bell while the door is opening and closing, but the bell does not sound when the door is completely open or closed. Another device to perform this same service is the door trip, Fig. 3, which is installed over the door on the inside, and announces the entrance of any one by ringing a bell when the door passes the trip, but is silent when open or closed.

Window springs, Fig. 4, are set into the window frame by boring or cutting a small hole in the frame itself, and a V-shaped cut made in the sash. When the window is closed the V-shaped part of the

FIG. 3. DOOR TRIP.



Open. Closed.

FIG. 4. WINDOW SPRING.

device fits freely into the niche in the sash and the circuit remains open until the window is moved upward, when the V wedge is forced back into the device and rings a bell the same as any ordinary push button. This device makes one of the best burglar alarms for a store or office having a window out of the range of general observation.

Often times any of these devices may be connected to advantage to an automatic drop, Fig. 5, by which the alarm, once given, will continue ringing until the drop lever is replaced by hand.

It may be said to advantage, right here, that it is best to select an alarm bell that will keep dust proof and in perfect adjustment, and it is advisable to select a large gong, say 3½ or more inches diameter, with sufficient battery supply to bring out all the sound there is in the bell.

Electric burglar alarm matting is constructed along the lines of push buttons; that is, the carpet or matting has push button contacts all along the *under* surface, and the lightest tread on the matting rings the alarm bell. The matting is sold by the square foot and is used in front of safes, stairways and doors.

FIG. 5. AUTOMATIC DROP.

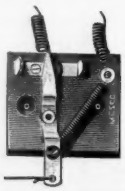


FIG. 6. ALARM TRAP.

Properly adjusted throughout a residence or store it proves a most satisfactory appliance. Fig. 6 illustrates a device which may be placed across a path or hall or

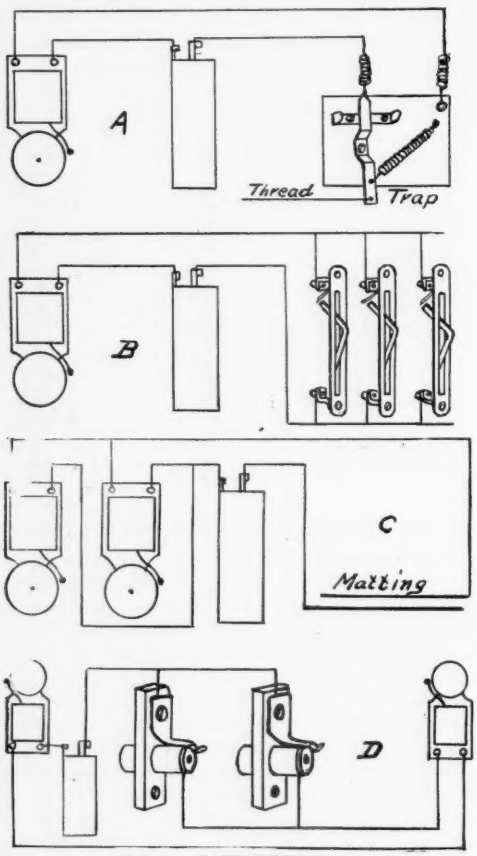



FIG. 7. ALARM CIRCUITS,

stairway, and by means of a dark and inconspicuous thread or string the alarm is set off electrically, should the thread be cut or pulled by a trespasser.

Now, as to methods of wiring. It was in the early days of bell wiring desirable that the batteries be placed on a shelf in the cellar or basement out of harm's way. But with the introduction of the dry cell much of this practice was done away with, because dry cells never leak or damage surrounding objects and may be stored on shelves or in any convenient place, at the owner's option. Dry cells are very popular for burglar alarm work and, because of their cheapness and cleanliness, are commended for this service. The best quality of insulated wire will be

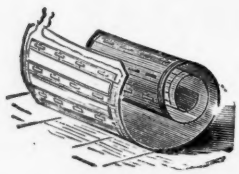


FIG. 8. ALARM MATTING.

FIG. 9. ANNUNCIATOR.

found the cheapest, and the gauge No. 18 is most desirable. Tacks should never be placed over two wires.

Fig. 7, *A*, illustrates a circuit comprising one burglar device, battery, wiring and bell. In *B* is shown one set of batteries operating one alarm bell connected to three burglar devices. In *C* we have two bells operated *in multiple* by one device and one set of batteries. Fig. *B* illustrates two bells and devices, one battery, and both bells ring when either device operates.

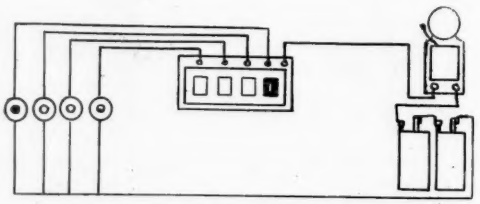


FIG. 9A. FOUR DROP ANNUNCIATOR CIRCUIT.

In connection with burglar alarms, where there are more than two doors or windows equipped it is often the practice to install "annunciators" to register the exact location of the alarm. Fig. 9 shows an annnnciator of a reliable type. The names, or numbers, of the doors or windows can be noted on the shutters when desired. The cases are finished in polished hard wood and look well in any part of the house.

Fig. 9A shows an annunciator circuit for four devices which may be on doors, windows or matting as desired, a set of batteries, a loud ringing bell and an indicator for each device. Thus, the annunciator signal tells at a glance which signal has operated. By this system quicker action can be taken in time of emergency because the exact location of the trouble is known immediately.

# OIL STONES.

HARRY MALONE.

The oil stone is such a simple thing that one is liable to neglect it and not give it the attention which it should have, and yet for the patternmaker it fills a very important place.

Until within a few years, all of the oil stones used were of the natural stone variety. Among the different stones found and used for sharpening tools, only two have ever found very extended use in this country. These are the Arkansas and the Waukesha. Both of these are fairly fine grained stones, of which silica is the principal ingredient. The prime requisite of any cutting stone is that it shall be composed of small angular particles of the cutting material, which are bound or cemented together with a suitable bond. This bond must be of such a strength that it will hold the particles until they have done a considerable amount of cutting and have become quite dull. When the particles have become dull enough to exert considerable resistance to the object being cut, the bond should give away and allow them to pass off with the material ground from the tool and this removal of the particles would expose fresh surface or cutting edges.

The object of oil or water on an oil stone is two-fold. First, it is used to remove the material cut from the tool in being sharpened; and second, for the removal of the particles worn from the stone. From this it is evident that the oil or other fluid used on the oil stone must be of such a nature that it will carry off these particles and that too without forming a gum which would smear and stop up the space between the cutting points. The trouble commonly known as glazing in an oil stone comes from the filling of the spaces between the cutting points, mainly with metal cut from the tool being ground, though the presence of some thick oils hastens the process greatly and the glazing material generally contains some of the particles ground or cut from the tool. To prevent glazing, a considerable amount of fluid must be used for carrying away the particles of steel and stone. The natural oil stones mentioned above possess especially fine cutting properties, coupled with an extremely fine grain, which fits them for fine work.

Natural stones, however, do not run uniform, and the stone beds are interlaced with small veins of quartz, which makes it impossible to obtain large stones clear from these quartz seams, and such seams injure the quality of the stone greatly.

The finer the oil stone, the greater care should be taken with it, and upon fine stones nothing but the best of oils should be used. Nothing will gum up an oil stone quicker than a thick, heavy machine oil. The best oils for the ordinary grades of oil stones are olive oil or sperm oil, the latter being preferable. Plenty of oil should be used and the surface wiped off frequently with a piece of waste or cloth. It must be remembered that the proper function of the oil is to carry away the cuttings and that this can not be done unless the oil itself is removed after it has become charged with the cuttings. Too many persons think that the oil is simply for a lubricant and seem to imagine that the material cut from the steel is going to evaporate in some mysterious way. If the bond of one of these oil stones is weak it sometimes overcomes all difficulty itself by breaking down readily under the heavy pressure necessary to overcome the partially glazed surface, and the necessary wiping of the tools with shavings or waste removes the oil and cuttings. But the best and highest grade oil stones do not break down as freely as this, and hence greater care should be taken with them. Frequently it is well to clean a stone which has become somewhat gummed up with gasoline or benzine. This will dissolve the oil and leave the stone with a fresh surface for work.

If the stone has become badly gummed with the heavy machine oil, it is necessary to soak the stone in a strong lye for several hours and then rinse it off in clean water and wipe it dry. The lye will cut the grease and serve to put the surface of the stone in better shape. In many shops where soda kettles are used, it is common practice for the men to dip their oil stones into the soda kettle to clean them.

If the surface of one of these natural oil stones becomes worn out of true it may be smoothed or trued up in any one of a number of ways. Small stones may be ground true very readily by applying them to one side of the grindstone. If no grindstone is at hand emery may be placed on a cast iron plate, water added, and the stone ground down by hand upon the iron surface. The plate should be planed true both to produce a true surface and to remove the scale so that the grains of emery can get a better grip on the iron.

A sheet of lead placed upon a true, flat surface, or a sheet of zinc may also be used to support the emery and water. If the stone is fairly soft, good sharp sand may sometimes be used in place of emery, but it will not cut it as fast. Where none of the above-mentioned metals are available, the emery and water are sometimes used on the surface of a smooth board. Sometimes an oil stone is dressed off by placing a sheet of sand paper or emery cloth upon a board, sprinkling it with emery, applying another coat of glue and another coat of emery, etc., until several coats have been applied and dried upon the surface. The oil stone may be very quickly trued upon the surface.

While all of the above named processes apply very well to natural oil stones, the artificial oil stones come under a very different class. There are three kinds of artificial oil stones now made. First, plain emery slips or blocks; second, Indian oil stones which are made from Indian corundum, and third, the carborundum oil stones. All of these are so hard that they cannot be ground or trued up on a grindstone. They may be trued, however, by using emery, corundum, or carborundum upon an iron plate or lap, as above described.

What has been said as to the use of oils on an oil stone applies equally well to the artificial stone, except that some of them will cut as well with water as they will with oil, providing plenty of water is used.

They say a good workman is known by his tools, but no good workman can keep his tools in good shape if he does not possess a good oil stone, and hence great care must be exercised to keep the oil stone in proper condition. No regular sharpening oil stone should be used without having a definite place to keep it, where it will be protected from the dust and dirt. For this purpose it is best to set the stone in a wooden block and provide a wooden cover for it. Some parties recommend the placing of a piece of hardwood, such as hickory, at each end of the stone and dressing it off level with the stone so that the entire surface of the stone can be used without fear of damaging the point of the tool by dragging it back off from the edge of the stone, as with the piece of wood flush with the surface of the stone the tool would simply glide over it. *Patternmaker.*

# HOW TO BUILD A POWER LAUNCH.

CARL H. CLARK.

## III. Getting Out and Putting On the Planking.

Great care must be taken that the frames do not change their shape after being bent into place. There is always a tendency for the frames to straighten out after a time, and this must be guarded against. The bilges are the points where this change is first noticed, as there will be a tendency for the bilge to become more round than when they are bent. This would give the boat less displacement than designed and be less satisfactory. It can be guarded against by laying short pieces in the bilge across the three frames between each two moulds and running a brace from them to the beams overhead. This will keep the bilges down into place and make the structure stronger during planking.

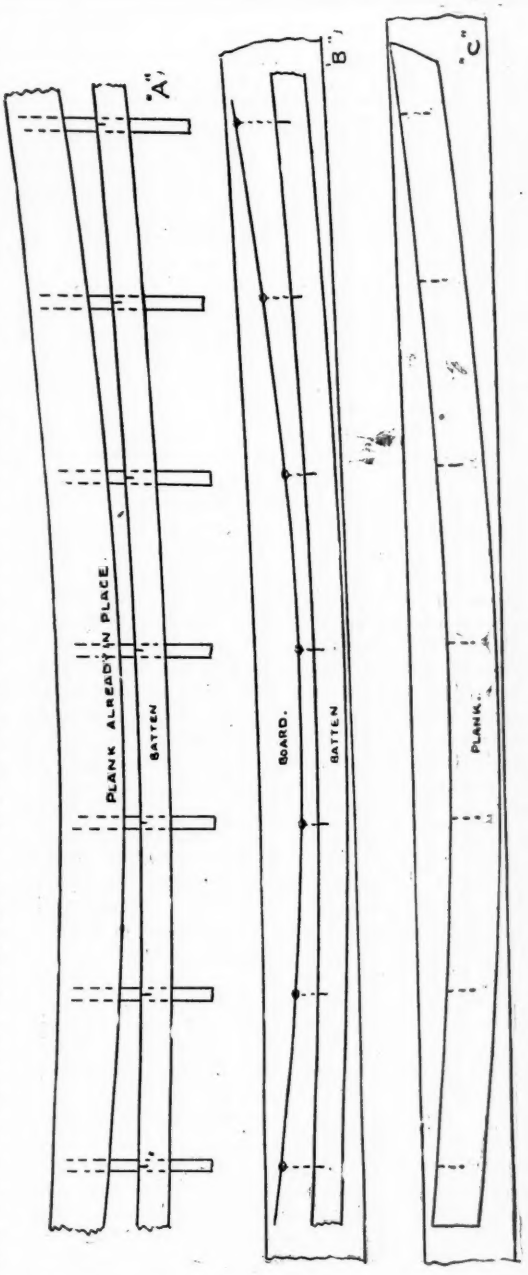
A floor, as shown in the cross section, is bent in on the top of each frame; this floor is a piece of the same section as the frame and about 24 in. long with the outer corners rounded off. It is steamed and bent down the throat of the frame and held there by a large nail driven through. These nails should be galvanized, 3 in. long and of the wire type, as they do not cut such a large hole in the floor as the cut type. It will be found necessary to bore for these rather smaller than the nail and yet have a good driving fit. In the forward end of the boat the angle of the frames will be so acute that the floors cannot be bent in, and either a natural growth knee must be used or a piece of ⅞ in. board cut to shape and fitted alongside of the frame and fastened through. At the stern, floors must be worked over the horn timbers, bent to shape or of a piece of board notched over the horn timbers and fastened alongside of the frames. These floors are a very important item in the construction, as they tie the two sides of the boat together and add greatly to its strength, although they are a matter which is often neglected by builders of small launches

The rabbet in the keel is to be trimmed out so that a ¾ in. plank will lie on the frame and bed firmly into the rabbet. The angle will, of course, change at all points, and can be obtained by laying a piece of ¾ in. board with square edges onto each frame and trimming out the rabbet until it fits squarely into it. The rabbet in the stern is trimmed to suit the squared end of a long piece which is bent around the frames about as the planks would run. The sternboard also must be bevelled off to the correct angles, as shown by the ribband bent around the frames and across the sternboard.

In planking, the top streak should be the first to be put on, as it will stiffen the boat, and is also the easiest. The height of the sheer, as marked on the moulds, is that of the deck or top side of the covering board, and since the covering board fits on the top of the top streak, we must fit the latter ¾ in. below the marks already made in the moulds. A ribband should be clamped around the tops of the frames ¾ in. below the marks already made and the sheer line marked on each frame, not only on the face, but on the sides. The plank may be either hard or soft pine, or cedar; the first is rather harder to work, but comes in long lengths and is a very strong wood, making a very smooth boat, while the two last are easy to work and fit, but come in short lengths, requiring many butts, but are, on the whole, more economical of stock. It is advised in any case, that the top streak be of oak, as it may be finished bright and is very ornamental. If possible there should be no butts in the top streak. The boards from which the planks are to be fashioned, must be much wider than the plank which they join. On account of the curvature of the

plank, this width will sometimes need to be nearly double that of the plank so that the boards for this purpose ought to be 12 in. or so in width. To lay out the top streak, the boat is laid on the frames, bent around and clamped into place, the marks made on the sides of the frames are transferred to the plank, thus giving the curvature, the mould points are marked across the plank to enable it to be replaced in the same position, fore and aft. The plank is then removed and a line drawn through the points with a pattern. There will be a considerable amount of curvature to this plank so that it cannot be gotten very wide out of a single board; this width should, however, be made as great as possible, up to 7 or 8 in. The lower edge of the plank is also laid out, it being tapered somewhat toward the bow and rather narrow at the stern.

The plank is now sawed out and the edges planed carefully. It is then clamped on to the frames again and fitted to the marks, and necessary fitting done. Care is to be taken that it is replaced in exactly the same fore and aft position as when the marks were made. The forward end may be cut off to fit the rabbet; the angle can be obtained by laying a rule or straight edge across the plank and sighting it even with the edge of the rabbet. It should be cut off with a fine tooth saw, leaving a smooth end. The after end is left long for the present. In fastening the plank on, the forward end should first be clamped to the stern and pressed firmly into place then bent around and clamped wherever possible. All fastenings must be bored for and should be set below the surface of the plank ¼ in. by boring with a larger bit, the hole thus left being plugged later. At the stem and stern the fastenings are brass screws about 1½ or 1¾ in. long. The frame fastenings may be either copper rivets or galvanized iron nails. Brass screws are sometimes used, but the writer does not recommend them, on account of their brittleness. Galvanized iron nails are cheap and strong, but should not be too large wire, and should be clinched on the inside; this makes a very good piece of work. Copper rivets are, however, the most satisfactory fastening, although they cost somewhat more and are rather more work to put in. A boat fastened with copper is, however, more valuable, and this fastening is recommended with a washer on the inside. Nails for this purpose should be long enough so that there is about ¼ in. to cut off before riveting, as in this way the strongest part of the nail is used, the point being so slim as to have but little strength. In fitting, the washer or burr is driven on to the rivet with a rivet set. This is a piece of steel with a hole in it rather larger than the rivet; and by using this and holding a heavy pointed piece of iron against the head, the burr, which should be a close fit for the nail, may be driven on tightly, drawing the plank and frame together. The end is then cut off, leaving about ¼ in to head over, which is done with a riveting hammer, the weight being held against the head as before. This makes a very firm fastening, when well done, but the hole for the nail must be a driving fit with no play, or




the nail will cripple or bend when riveted and a poor fastening will result. The top streak should be fastened thus along the lower edge into every frame and at intervals along the top edge; the latter is not very important at present. The second streak may also be put on, as it is desirable that some experience should

be obtained before going to work on the more difficult planks on the bottom. On this plank it may also be possible to obtain the curvature by bending the board around and marking it, but practice should be obtained in taking the "spiling" or curvature by measurement. The space around each mould between the lower edge of the top streak and the keel should be divided up into the same number of equal parts of about the width which the planks will be. This is for use as a guide in making the several planks taper regularly towards the ends.

The method of laying out the plank is shown in the illustration; the batten is about 4 in. wide, so as to bend without springing sidewise, and about ¼ in. thick. It is laid on around the frames near the edge to which the next plank is to be fitted, and clamped in place. Measurements are then taken from the edge of the planks and recorded in chalk on the bottom, together with a mark showing just where the measurement was taken; as shown in the figure, sketch *A*. It will be seen that this bottom simply locates a base line from which measurements may be taken. The bottom is then laid on the board from which the plank is to be cut, as in sketch *B*, and the measurements laid off onto the board. A line drawn through these points with a narrow batten is a very close approach to the true shape. The wide batten may now be removed and the lower edge of the plank drawn in, tapering the plank towards the ends, as before directed; the divisions already marked on the moulds will aid in making the taper equal on all the planks. When the plank is shaped it will look like sketch *C*, the mould points being marked in it to facilitate replacing it in the proper position. It is then cut out and smoothed up with a plane. The plank is then bent around in place and any discrepancies noted; the forward end is cut to fit the rabbet. It is taken down, the necessary fitting is done, and the planks may now be used as a pattern for the corresponding plank on the other side of the boat, which is fitted into place in the same manner.

The lower edge of the planks must be planed fair and true, as it will be impossible to alter it after it is fastened in place. The plank may be fastened with the nails, as before; it must be pressed firmly into the rabbet of the stem and fastened there first working from the bow toward the stern, fastening the frames in order. There should be three nails in each plank if it is over 4 in. wide, and four nails if it is 6 in. wide. The nails should be driven about ⅜ in. from the edge to make sure not to split the plank. While driving the fastenings the plank should be firmly pressed against the one above, either with clamps made for that purpose or shores from the floor; the joint should be as close as possible on the inside and just slightly open on the outside, to allow the insertion of calking without spoiling the edges. It will not be advisable to put on more than three streaks before beginning to plank at the keel.

The lowest plank, or garboard is probably the most difficult plank to fit on account of its curvature and twist. The spiling for it may be taken as already described, and it may be desirable to make an actual pattern out of ¼ in. stock, which may be bent and fitted much more easily than the thick planks. This garboard will require very careful fitting, as this joint is the most troublesome of all in the boat.

The aid of shores from the floor is very helpful in holding the plank up into place during fitting. The garboard should be of about equal width the whole length, and should run to a point aft, being carried as far up the rabbet as it will go naturally, but care must be taken not to split the plank at the ends where it tapers off. The remainder of the planking can be completed in the same manner as just described.

It will be found that, owing to the curvature of the bilges, some of the planks will require to have their edges bevelled to bring them to bear, and the bilge planks will probably need to be hollowed out somewhat on the inside to fit the frames, as it will not be possible to curve the plank without splitting it.

If possible, the planks should be put on in a single length, but when the curvature is so great that a board cannot be obtained wide enough, it will be necessary to make a butt, or joint. The two pieces of the plank are to be fitted independently, and at the proper point the ends are fitted together midway between two frames, and a piece of board fitted in over the joint; the ends of the two parts are now fastened to the block, making a very strong joint. The joint should not be made on a frame.

The planking should not be a very difficult piece of work, although at first it takes a considerable amount of time, as it has been laid out here, the amateur will have obtained some little experience on the easy parts before taking up the harder parts. The fastenings of the garboard and lower stakes should be planned to go also through the floor timbers, which are on top of the frames and thus bind the plank, frame and floors firmly together.

After the planking has all been fastened and riveted it must be smoothed outside with a plane, all the uneven edges being taken off with a coarse set plane, then with a smoothing plane. The ends of the plank extending beyond the sternboard must be cut off and the ends smoothed down to the surface of the sternboard. It is hardly necessary to say that the fewer butts there are in the planking the better, and where they do occur those in adjacent planks should be in opposite ends of the boat and well shifted from one another.

After planing, the plank should be sandpapered smooth and round. All flat spots should be planed off and when finished the planking should present a perfectly smooth surface with no flat or straight spots.

The seams are now to be calked with a thread of cotton, which is driven in with a calking iron; the latter can be purchased of any dealer in marine supplies at a small cost; a mallet is used to drive it. In using, a single thread of the cotton is used, a small loop is gathered up and driven into the seams; an inch or so further along another loop is formed and driven in.

After a foot or two of length has been covered in this manner, it is gone over and driven in rather tightly. Where the seams are very small no loops may be required, the thread of cotton being driven in straight. The amount driven in should be according to the width of the seam.

Great care must be used in driving the calking, as it is possible to force the plank off the frames if it is driven too hard. It is also well to paint the seams with a very narrow brush before driving the calking, as it holds in place better when this is done. The process of calking will probably burr up the edges of the plank somewhat, and they should be gone over with sandpaper and the burr removed. It is advised that the plank should be well covered both inside and outside with a coat of linseed oil, letting it soak into the wood, this will prevent a large amount of shrinkage, especially if the boat is in a warm place. It will do no harm if the plank is painted one coat, priming paint being used.

# TOOL MAKING FOR AMATEURS.

ROBERT GIBSON GRISWOLD.

## VI. Making a Set of Arbors.

The tool chest of any amateur that has any pretensions at all in the line of nice machine work is not complete without a set of lathe arbors, known by some as mandrels. It is true that this set requires the use of a grinder, but one may be easily rigged up in the tool post of the lathe that will do admirable work, but the description of it will not be given until the next issue, as the lathe work of this set will require quite as much spare time as the amateur will care to put upon it in the interim.

All accurate turning upon pieces having central holes is done on these arbors, which are forced into the hole with some pressure, and the arbor is then swung between the lathe centers, being driven by a dog fastened to one end and driven by a face plate. The very truest work may be done on them, and their convenience more than pays for the expense of making.

Opinions as to the best material for this work varies, but the writer recommends the use of a good quality of tool steel, such as may be obtained in rolled steels. It is not well to trust to case hardening in such accurate tools, and a tool steel arbor may be hardened and ground with great nicety, and it is very hard to destroy the finished surface by an accidental contact with the tool.

The sizes that will be found most useful to the amateur, together with the best lengths over all are given in the following list:

| Diameter. | Length. |
|---|---|
| 1/8 in. | 2 in. |
| 3-16 in. | 2 1/2 in. |
| 1/4 in. | 3 in. |
| 5-16 in. | 3 1/2 in. |
| 3/8 in. | 4 in. |
| 7-16 in | 4 1/2 in. |
| 1/2 in. | 4 1/2 in. |
| 6-16 in. | 4 3/4 in. |
| 5-8 in. | 5 in. |
| 11-16 in. | 5 1/2 in. |
| 3/4 in. | 5 1/2 in. |
| 7/8 in. | 5 3/4 in. |
| 1 in. | 6 in. |

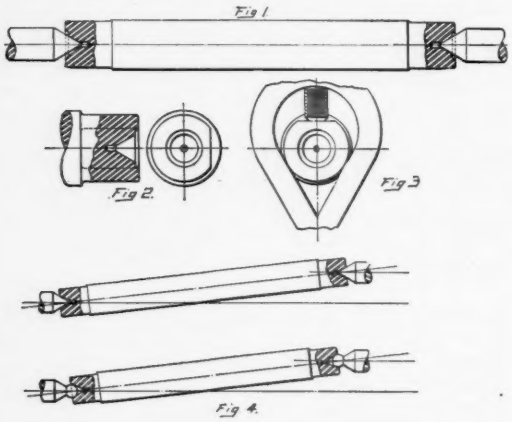
The diameter of the smaller sizes may be out of proportion for their lengths when very heavy cuts are to be taken, but if such work is intended another set of shorter arbors should be made that will stand the strain better. It is seldom necessary, however, to use the smaller sizes in heavy work.

In Fig. 1 is shown an enlarged view of how an arbor should hang on the lathe centers. The holes should be drilled deep enough so that the point of the center will not touch the bottom, thus tending to wear it to a blunt point instead of a sharp point. The depth of the taper should be such that a considerable portion of the center is taken in, so that the load will not come near the point, which in very heavy work would crack it off. Then the wearing surfaces are much larger and the wear on both the arbor bearing and the lathe center is reduced. The countersunk hole in the end does not end flush with the surface, for the following reason. When the arbor is driven into the piece to the turned, any blow on the end would cause the metal to be bruised or spread into the hole, thus causing it to run out of true. To obviate this, the end is provided with another counterbore, as shown, leaving a ridge of metal to drive on around the hole, which will prevent the hammer striking the edge of the countersink. Some mechanics prefer the edge of the hole to be rounded off in a fillet, while others prefer it terminating in a sharp edge, as shown.

The pieces of stock having been cut for the various drill in the end of the first three sizes a large 1-16 in. hole and a 3-32 in. hole in the ends of the larger sizes. Then place on the centers and take a light cut on each so that they may be run in the steady rest. Ream out the centers with a 60° reamer held in a drill chuck in the tail spindle, guiding the end of the arbor in the steady rest. Make this hole as true and smooth as possible, and with a tool relieve the metal for a distance of 3-32 in. away from the edge of the hole in the larger sizes, and about 1-16 in. in the smaller sizes. Then mount the arbors on the centers and turn to within about .012 or .015 in. of the finished size, this being left for grinding. The ends are turned about 1-16 in.

less in diameter than the body part, and a flat is filed filed on the side of each to take the dog screw. This is shown in Fig. 3.

All arbors are made with a slight taper in the body, the exact size being maintained in the middle, and one end is made about .001 in. small, and the opposite end




about .001 in. large. This small taper enables a very tight driving fit to be made in the piece so that the friction will hold it securely. In the sizes above ½ in. perhaps the difference may be made .0015 in. on either end. This taper need not be made in the turning, but the tail spindle should be set over sufficiently to make this difference when grinding.

Having turned all the pieces approximately to size, they are now ready to be hardened. Take time to heat them evenly throughout and then dip them in oil instead of water. In dipping, keep them perfectly vertical and do not move them to and fro, as that will have a tendency to make them bend out of shape. Move them up and down in a vertical line, while cooling. The temper should then be drawn evenly to a dark straw color, because if they are left too hard they are liable to crack when struck, or when the load is put on them.

The holes in the ends are now to be finished very carefully, because upon the accuracy of these depends the accuracy of the grinding to a great extent. Turn up a piece of copper to exactly 60° and hold in the drill chuck in the tail spindle. Then carry one end of the arbor in the steady rest and feed the copper into the hole, first covering it with very fine emery and oil. This forms a copper lap and will lap the hole out true and round if too much pressure is not used. Finish with a little crocus or rouge until a polished hole is the result. The opposite end is, of course, supported on the live center and driven by a dog. In order that it may not slip off, a strip of rawhide lacing may be tied tightly around the dog and then to the face plate.

The next operation is grinding the body, but the description of this process will be deferred until the next chapter. Prepare two ball centers, as shown in Fig. 4, making the balls about 3-16 in. in diameter and perfect spheres. Harden them and draw their temper to a purple, and polish the surface as smoothly as possible. These are to be used in grinding the arbors and correct the necessary errors introduced by setting over the tail stock. Balls can be obtained of dealers in machinists' supplies.

# KEROSENE BURNERS FOR AUTOMOBILES.

J. FRAZIER BARD.

I have been experimenting on this line for the past three years. When I first took this subject up I was told by all the experts I asked for information on the subject, that it could not be done on account of the kerosene cracking under the influence of heat and clogging the passages with carbon, and also causing a smoky flame. They all said that the only practical method was that based on the spray or atomizing principle, either by pressure from the boiler or by compressed air. One of the engineers of the Westinghouse Air Brake Co., who was familiar with the attempts to burn oil in the locomotive fireboxes of several of the Southwestern railroads, told me that they had not been able to overcome these three objections—smoke, carbonization at the tip of the jet, and a loud, disagreeable, roaring noise.

I have already had some experience with jets of this type, and while I never had any trouble with carbonizing or smoke, I had never been able to suppress the roaring, and this alone made this form of burner useless on an automobile, as you could hear the burner for a quarter of a mile. Besides, it required either compressed air or steam to atomize the oil. Compressed air gives a better fire, but requires a constantly working pump to keep up the pressure in a supply tank, which should be heated by exhaust steam from the engine. Steam, while not giving quite as clean a fire, is much simpler to apply, only needing a pipe and valve from the boiler; but, on the other hand, to start the fire under a cold boiler requires air pressure to be pumped into the burner by hand until the fire has raised 15 or 20 pounds of steam. The best system of controlling the fire is to have the automatic regulator control the steam or air supply, and to supply the oil from a float-feed chamber, which would keep the oil supply level of the atomizer. I finally abandoned the atom-

izer principle, on account of the objection noted above, and turned to the Bunsen-burner principle.

I started out with a burner of standard design— *i. e.*, having air flues through the body of the burner. I soon found out that, except when the fire was burning very low, the pressure in the firebox was above atmospheric pressure, which caused a sllght back pressure down the draught tubes in the burner. Evidently, under these conditions the tubes were useless for the purpose they were put there, and, if anything, they allowed the fire to down flash and retard the draught through the boiler rather than the reverse. I put a solid plate under the burner, practically closing the holes airtight, and the fire drew up into the boiler flues better, and gave no indication of smoke or lack of air. From this I deduced the first requirements of a satisfactory burner—viz.: that the proper amount of air for perfect combustion should be mixed with the jet of gas in the interior of the burner, and then driven by the pressure right through the firebox and up through the boiler flues. The burner being solid and the firebox airtight, and there being a slight pressure above atmosphere in the combustion space, the result is a forced draft, and there can be no such thing as back draught, even if the wind should blow straight down the stack.

I now found that my vaporizer was not making an invisible gas, but a misty sort of steam when the burner was on full, but when throttled down about one-half it was invisible, until the automatic valve shut down to its lowest limit, when the vapor again became visible. The vaporizer plainly was not heating the oil hot enough to make a superheated vapor, first when the valve was supplying fuel to the full limit of the nozzle, and secondly, when the pressure in the burner dropped and allowed the fire to drop down under the vaporizer. I now found that the jet and cooler parts of my vaporizer began to clog with carbon; but the hottest parts showed no signs of deposit. From this I argued that the vaporizer must be red-hot all the time, and not allowed to flood into a partly-cooled vaporizer to recondense the vapor and deposit the carbon. I had now found requirement number two.

As my burner could not very well be adapted to an inclosed pilot light to keep a continuous heat on the vaporizer, I began looking for a burner which had a pilot light built into the body of the burner. I found a burner on the market which seemed to embody both my requirements. I fitted one to my car, and with it I fitted an automomatic regulator which would control the oil supply before it reached the burner and cut it off entirely when the steam pressure rose so the predetermined point, leaving the pilot to keep the vaporizer hot. I soon found that increasing the oil supply up to a certain point would increase the fire correspondingly; but beyond that point the vaporizing tube would seem to be unable to take care of the oil, and would flood just like a flash boiler when more water is supplied than the fire can evaporate. I remedied this by increasing the length of the vaporizer coil, which consisted of a piece of seamless steel tube of 1¼ in. pipe size.

The burner has been in use since August, 1903, and has driven my car upwards of 4000 miles. The vaporizer has never shown the least sign of carbon deposit, and the gauze strainer in the tip of the jet has only been examined three or four times, and each time only a few pieces of scale from the inside of the tube were found to have lodged in it. This, to me, is absolute proof that coal oil will not deposit any carbon when vaporized in a red-hot tube, and not allowed to cool or recondense before it is delivered to the burner. The burner itself shows no signs of carbon and burns a perfectly blue flame with never a sign of smoke. This method of burning the fuel is practically the same as in an internal-combustion engine, as after they have introduced the proper mixture of air and fuel, it is not considered necessary to have any additional valves for introducing more air during the combustion stroke, so why should there be any additional air introduced into the firebox under a boiler if there is already the proper proportion mixed with the fuel before it issues from the burner? This proportion is easy to obtain by simply varying the distance between the jet and the mixing-tube, and this proportion will remain nearly constant, automatically, as the airfeed will vary with the velocity of the jet of vapor. The fact that you have a combustion mixture in the burner would at first sight promise lots of trouble from back-firing into the interior of the burner; but, as a matter of fact, this never happened to me but once, and then was caused by the door in the casing being left open and the flame flaring out and igniting the gas at the jet.

To sum up, the requirements of a kerosene burner are:

1. No air supply to flame, except the proper proportion for complete combustion, which shall be intimately mixed with the vapor before ignition. This means a closed firebox.

2. All regulation of fuel to take place before vaporization. This means no cracked oil or condensed vapor in tubes, and hence no deposit of carbon.

3. Ample vaporizing coil kept at a cherry-red heat. This means perfectly dry vapor, no matter how hard the burner is forced by high pressure on fuel.

A burner which fulfils the above conditions will give satisfactory results and vaporize and burn kerosene oil for an indefinite period without any of the troubles which every one seems to think are inseparable from using kerosene. The above is not a "theoretical dream," but an actual demonstrated fact, and some day will put the steamer where it belongs, as the finest touring machine to be had.—*Horseless Age.*

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Every amateur mechanic who wishes to keep posted, should regularly read AMATEUR WORK.

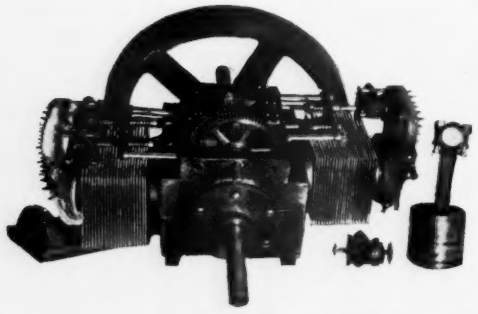
# A GASOLINE TOURING CAR.

R. G. GRISWOLD.

## III. Two Cylinder Air Cooled Engine.

As with every mechanism requiring a prime mover there exists a variety of motors that may be used for power purposes; in each class there also exists a number of types from which to select. The type adopted for this car has been chosen for several reasons, which will be enumerated.

As will be seen from Fig 7, it is a horizontal engine with two opposed cylinders. When well made this type of engine is in almost perfect balance, and runs at a high speed with remarkably little vibration, which can be scarcely felt in the car. The rating of any engine depends upon its revolutions, for one factor, while all others are supposed to remain constant. In this particular instance the rating is 15 h. p. at 1100 revolutions.



In regard to the cooling medium adopted, the illustration plainly shows that it is air. The air cooled motor, now being adopted by many of the largest automobile manufacturers, is free from many of the annoyances attending the water-cooled engine. There is no radiator, with its leaky tubes to bother with, no extra tank of water to carry, and no pump to drive. The saving in dead weight alone is a very important consideration.

The heat in this motor is carried away from the cylinder walls by means of copper flanges forced on. Copper has a high factor of conductivity for heat, and if sufficient area is given for the cooling action of the air, will keep the cylinder walls quite cool enough.

It is a popular fancy that a gasoline engine should be cooled down to a very low point, while the cylinders of a steam engine should be heated to as high a point as possible. But why so? They are both thermal engines, and certainly if the residual heat of the walls can be used to good advantage in the latter, why not in the former? The mathematical reasoning proves it to be a fact, so the fault must lie in some constructual feature if trouble is experienced. The greatest fault is here: The sliding surfaces of the cylinders and pistons must be lubricated, and the high temperature readily chars the oil; but now that oil manufacturers have given us high-test oils, if we can keep the wall temperature down to about 500° we need have little trouble. Beyond the lubricant problem comes the valve stem question. The high temperatures of the exhaust gases will often cause the stems to warp, if sufficient shield is not provided, and this readily allows leakage past the valve.

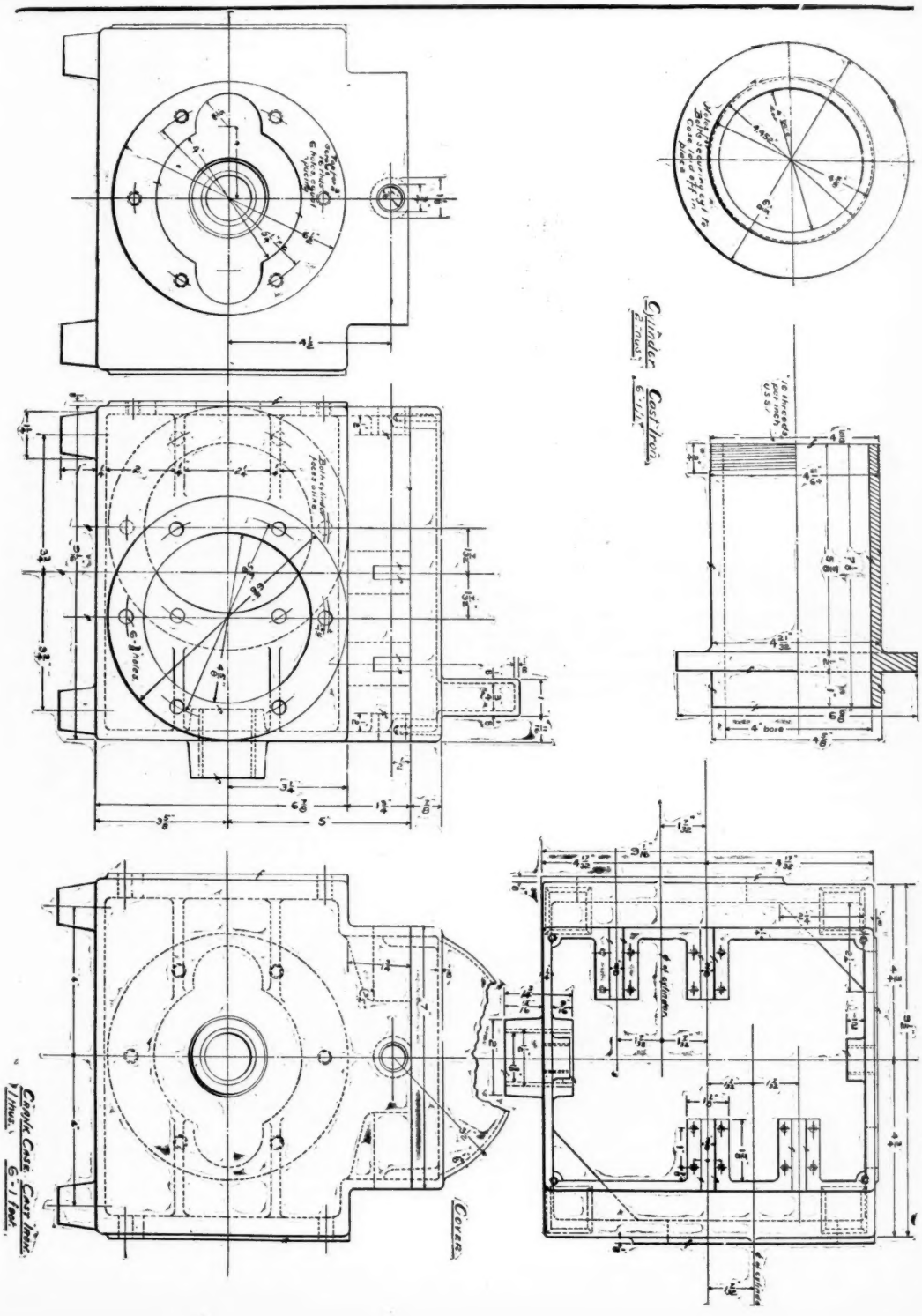
In this type of engine the reciprocating parts can be mechanically balanced without the adoption of web balance weights. Owing to this fact the parts may be made very light without materially reducing their strength. The advantages of the four cycle type may be obtained and still have an impulse every revolution by placing the cranks 180° apart. With the vertical types this is only possible with the cranks together, and both pistons travelling in sychronism, and owing to a balance being effected by means of web weights attached to the cranks, the effect of the reciprocating parts can be balanced at one speed only.

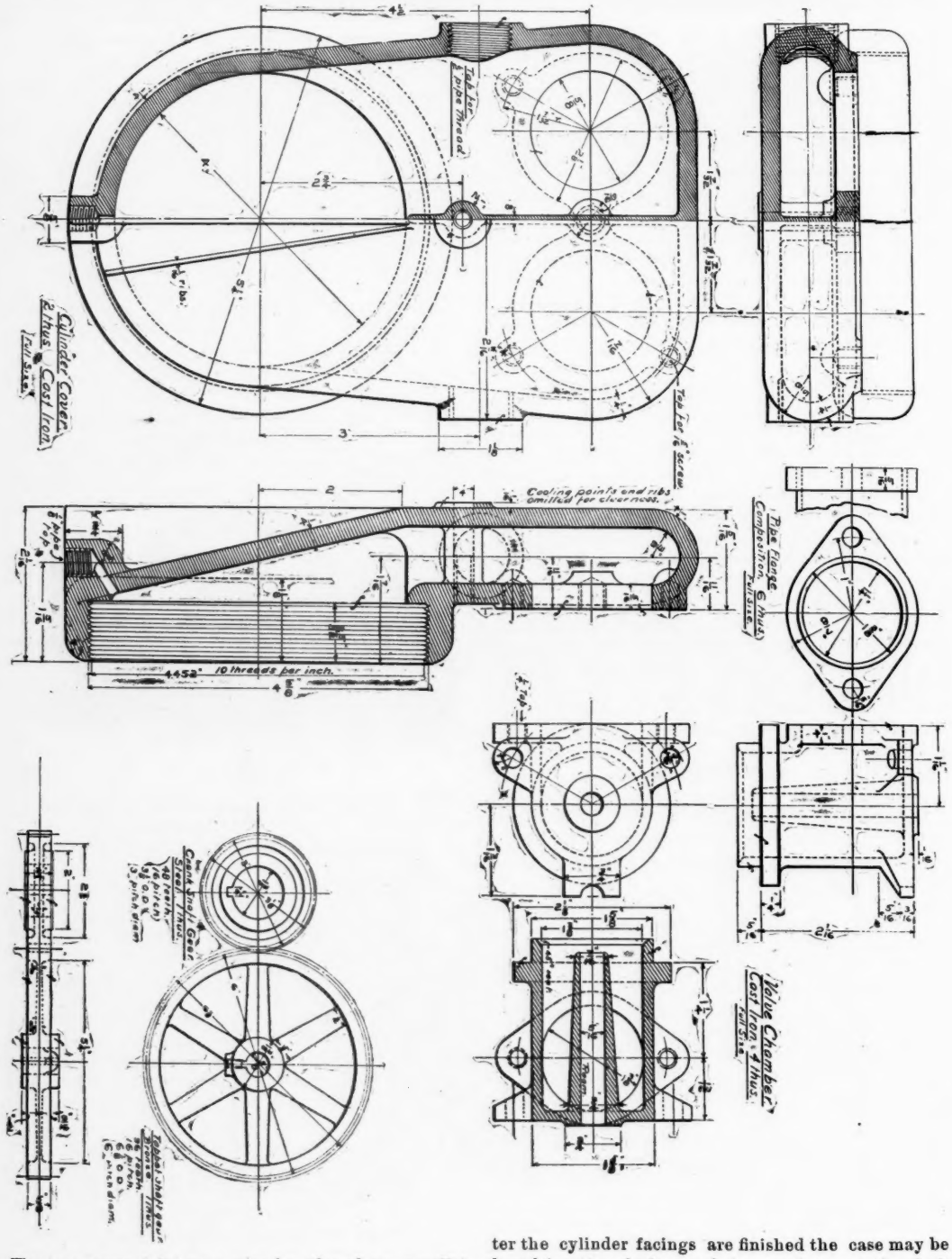
Furthermore, this method entails considerably greater work in machining the parts. If vertical two-cycle cylinders are used the cranks may be 180° apart and two impulses per revolution obtained, but this necessitates a two-part crank case with a middle bearing and its consequent inaccessibility, together with a far more deficiently machined shaft. All points considered, the horizontal opposed type is probably the best suited for amateur construction.

The cylinders are cooled by means of copper flanges forced on to the cylinder shell. This method is considered superior to that employing cast ribs, on account of lightness and the greater conductivity for heat of copper over cast iron. In this engine the valves are each carried in a separate casing, which may be readily removed for regrinding by inspection. The heaps and valves may be removed and replaced without disturbing any of the valve gear.

The completed engine is shown in Fig. 1 with one one piston and its rod standing beside the cylinder. The engine measures over cylinders, 26¼ in. and 12⅞ in. in height, while the the crank shaft may be made anything over 15 in. The fly-wheel is 19 in. in diameter with a 2 x 3 in. run.

Fig. 2 shows the details of the crank case and cylinder. The bottoms of the feet should be planed first to give a solid foundation for setting while performing the other operations. Then face the seat for the crank shaft loose bearing. This gives a large surface to square by for facing and boring the cylinder seatings.


Cylinder Cast Iron
Crank Case Cast Iron
Cover




The top cover joint may now be planed up parallel with the feet, and also the under side of the cover. After the cylinder facings are finished the case may be bored for the shaft, care being used to get the shaft bearings exactly square with the cylinders. The loose

bearings will be shown on another detail sheet. The bolt holes may now be located and drilled, which will practically finish the case.

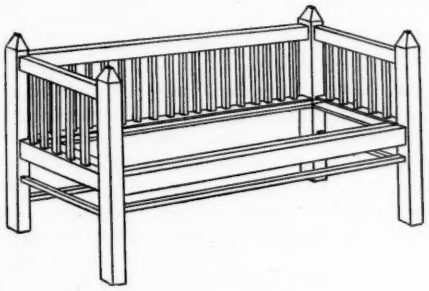
The cylinders are very simple pieces and require no intricate lathe work. The outside is given a very slight taper, so that the copper flanges, as they are spread on, will be a very close, tight fit. Upon this close fit largely depends their good heat conducting qualities. The bolt holes in the cylinder should not be drilled until the heads have been fitted and the cylinders put in place, when the holes may be laid on from the case.

Fig. 3 shows the details of the cylinder heads, valve chambers and valve gears. The heads are divided into two compartments, one carrying the cool, incoming gases, and the other the exhaust gases. The spark plug is situated in the inlet chamber, where the cool, incoming gases sweep by it and clear all carbon or soot deposit from it. The cooling points and vanes have purposely been omitted from this drawing for the sake of clearness. The head screws up against an asbestos gasket which cannot blow out. The valve chambers are readily machined and need no further description. The various other details will be shown in the next chapter.

# A LIBRARY SETTLE.

JOHN F. ADAMS.

The settle here described, while more particularly suitable for the library, will also be found a very useful piece of furniture for sitting-room, den or hall. It is four feet long and can be made of oak, stained to match other furniture, or in mahogany or gum-wood will look well. The seat is upholstered and fitted with stuffed cushions made with a box edge, as with a bed mattress.



The corner posts are 45 in. long and 2 in. square; the top ends having a 2 in. bevel, leaving the ends ¾ in. square. The cross-pieces are 1¾ in. square; those for the back being 47 in. long, and for the ends, 15 in. long, allowing 1½ in. on each end for tenons. The spindles are 13¼ in. long and made from ⅝ in. square stock spaced 1½ in. apart. There are 5 at each end and 21 at the back, thus requiring that the end spaces be 1⅝ in. wide. The mortises for the spindles should be slightly over ¼ in. deep and accurately spaced and carefully cut to gauge lines made with a marking gauge.

The top cross-pieces are 2½ in. below top of the posts and those at the seat are 13 in. below the top ones. The smaller cross-pieces under the seat are also ⅝ in. square, and of the same lengths are the larger ones. The front one is 2 in., those at the ends 3½ in., and the back one 6 in. below the cross-pieces for the seat. Care should be used in making the mortises for these pieces that their direction is exactly square with the posts to avoid any bending when the frame is finally put together.

Inside the cross-pieces forming the seat is fitted a frame of 1½ x ⅝ in. stock, the upper edge of which is ¼ in. below the top surface of the seat. To the frame are tacked the strips of webbing for the seat. The webbing may be of any width conveniently obtained, and should be woven after the fashion of willow seat piazza chairs, the ends being firmly tacked to the frame. A thin tufting of hair or jute can then be laid on and covered with cambric, also tacked to the frame. If cushions are not desired, the seat can be covered with leather, fastened with large flathead upholstering nails of a suitable enamel color. If such nails are used a piece of leather or carpeting must be placed on the head when hammering, to avoid breaking off the enamel. If casters are used, the legs should be cut off to make allowance for same.

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Those who wonder whether wireless telegraphy is really practical should notice what Gen. Greeley, chief of the army signal service, has to say on the subject. He is enthusiastic over the success attending the installation of a wireless system in Alaska. Hundreds of messages are being transmitted daily between Cape Nome and St Michael, a distance of 160 miles across Norton Sound. "Very little has been said about it in the public press," writes Gen. Greeley, "but we are demonstrating every hour of the day up in Alaska that a practical, working wireless telegraph system is possible. Our system has been operated there for more than a year, and with most complete success. Thousands of messages have been transmitted between the two points, and not only the private citizens but the government officials of that neighborhood are now largely dependent upon it. It is no longer an experiment. It is used for commercial purposes as well as for government business.

# AMATEUR WORK.

**DRAPER PUBLISHING CO., Publishers,**

**88 Broad St., Room 522, Boston, Mass.**

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

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Single copies of back numbers, 10 cents each.

**TO ADVERTISERS.**

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

## FEBRUARY, 1905.


That the readers of this magazine are interested in the forthcoming description of a small, easily constructed runabout, is abundantly shown by the large number of letters we have received in response to the editorial inquiry in the January issue. We are, therefore, having a description of such a vehicle prepared, and the first chapter will undoubtedly be published in the March issue of this magazine. We are able to state at this time that the design will be one which will admit of construction with a minimum tool outfit; in addition, the machine work will be reduced to the least possible amount. In this connection we shall endeavor to give information which will enable those building the vehicle to obtain the various parts at the lowest possible cost, and have been successful in locating quite a stock of such parts, which will be offered to readers of this magazine at exceptionally low prices. This description will be, therefore, of more than ordinary value, as it will enable many of our readers to gratify their desire to be included in the ranks of automobile owners.

We anticipate that the number who will be interested in this description will be large, as there are many machinists working in shops where the tool equipment could be utilized during spare time for the necessary machine work, as well as an equally large number of advanced pupils in Manual Training Schools who are also fortunate in having the necessary tool equipment at their command. Both of these classes will find the work of constructing this car easily within their capacity, and we shall anticipate the pleasure of hearing from the makers of the "Amateur" automobile as the description proceeds. Special attention will be given to answering the inquiries of any one finding it necessary to make them.

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It will be noted that this number appears in a uniform dress of type. The change to the smaller size throughout the whole of the magazine enables us to present the equivalent of about three additional pages of reading matter, which we are confident will be appreciated by our readers.

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A new alloy of aluminum which is claimed to have special qualities has been produced in Germany. It is known as zimalium. The alloy is formed by adding small quantities of manganese and zinc to aluminum infusion. It is harder than pure aluminum and takes the tool better. A sheet of the metal shows a traction resistance of twenty-five to thirty-five kilos per square millimetre, which is double that of aluminum. The wire has a resistance of thirty to thirty-seven kilos per square millimetre and an elongation of ten per cent. In some respects it acts like brass wire. The cast metal is easily filed, forged and drilled. The alloy has a lower conductivity than the pure metal, but its price is ten to twelve per cent less.

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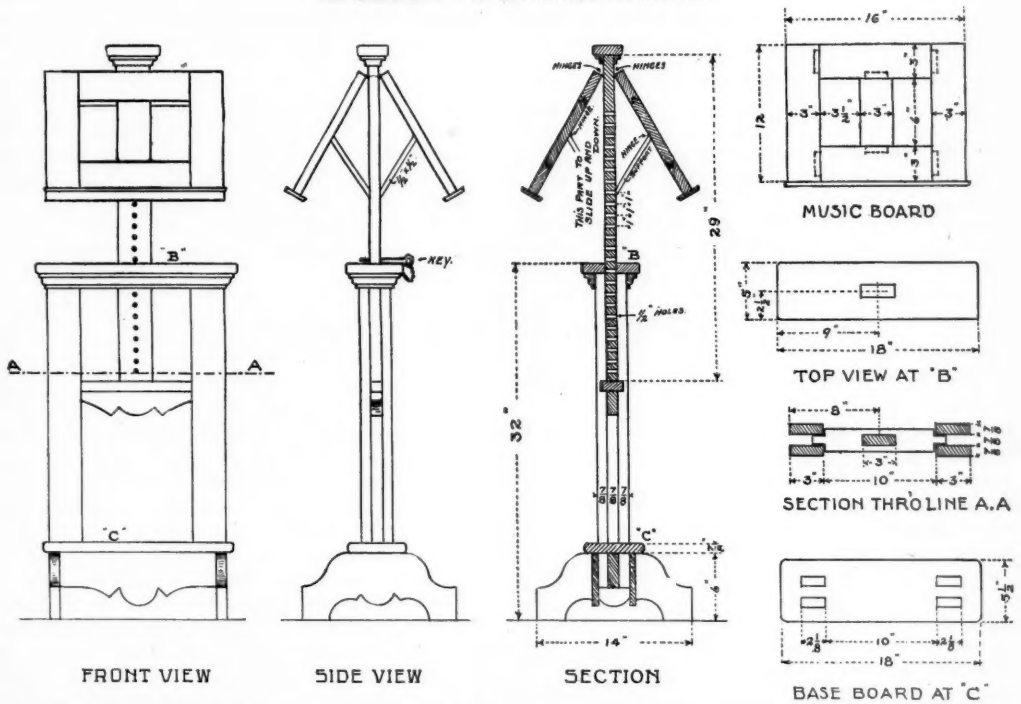
A new electric furnace method has been invented by a Frenchman, M. A. Nodon. The electro-negative metal is fused and used as a cathode in an electric furnace with a non-attackable substance, as an anode and an electrolyte of a fusible, only slightly volatile, halogen compound of the more electro-positive metal. When a current is passed through, the ionization produces a combination of the metals with liberation of the halogen. Other metals can be incorporated, the precautions necessary and the factors controlling the proportions required being described.

# YE OLDEN TIME MUSIC STAND.

THOMAS LLOYD.

This music stand is a very handy piece of furniture in the home where music predominates. On one side stands the instructor, on the other the pupil. It is preferably made of mahogany, but other woods can be used and stained as desired.




The music boards are made from ¼ in. stock and well tongued into each other, as shown. They are to have strips ½ in. thick nailed to the lower edges to support sheet music, etc. These music boards are to be hinged to a supporting upright so that they can be moved to any angle desired. The boards are held at an angle by a small piece of wood ½ x ½ x 6 in. One end of this piece is hinged to the back of the center strip of the music board, the other end is pointed to fit in the holes made in the supporting upright.

The supporting upright is made to slide up and down in the main body frame. It is to have ¼ in. holes bored into it, as shown, through its entire thickness, 1 in. from center to center. A key turned from wood is made to fit these holes to hold the sliding upright at whatever height desirable. This key may be fastened to the frame with a neat brass chain. All parts of the main body frame should be assembled in a workmanlike manner, so that the sliding parts will have free movement.

Among the more notable recent German inventions in the field of applied science is an electric resistance material for heating purposes, to which the name of "kryptol" has been given. The exact method of its preparation is not disclosed by the patent specification, but it is a mixture of graphite, carborundum and clay, and is made in four grades of coarseness. The property of kryptol upon which its efficiency depends is the fact that it offers to an electric current the requisite degree of resistance to generate a high degree of heat without destruction to its own substance. In its application to a cooking stove kryptol is sprinkled over an earthenware plate, and upon the current being switched on it readily generates sufficient heat to boil a kettle of water in three or four minutes.

# PATTERN MAKING FOR AMATEURS.

F. W. PUTNAM.

## XII. A Small Hand Wheel.

Fig. 76 shows a small hand wheel for a rapid-acting woodworker's vise, and Fig. 77 the pattern for same. It will be noticed that a hole $\frac{3}{4}$ in. in diameter is to be bored through the hub, and a small key-way cut out. This is done after the casting is made and does not concern tne pattern maker. This pattern may be made from one piece of stock $6\frac{1}{2}$ in. square and $1\frac{3}{4}$ in. thick. A circle 6 3-16 in. is marked on the block; and after the block has been cut to this circle it is placed on a screw center, and one side is turned up. The side which is turned first is the side *A*, Fig. 77. A templet should be made to fit the hollow at *B*. A templet to fit the arc of the circle at *C* will also be found useful. Care must be taken in hollowing out at *B* to get the depth exactly $\frac{1}{4}$ in. After the first side has been turned and sand-papered, a center mark is made at the center of the hub to serve for the hole for the screw center when the pattern is turned around. The opposite side is now to be turned, the rim being finished first. It will be noticed that the rim takes the shape of a $\frac{3}{4}$-in. circle; and it will be found advisable to finish this before the hollow at *B* is cut in. There should be left a thickness of $\frac{1}{4}$ in. for the arms or spokes of the wheel. The pattern is to be drawn out from the sand in the direction shown in the arrow and the hub should, therefore, receive a little draft. When the pattern has been finished in the lathe, the next thing to do is the marking out of the four arms. The grain should run parallel with two of the arms, thus leaving but two of the arms with cross grain. The top view of Fig. 77 gives the dimensions for marking out the hole necessary to form the sides of the arms. The arcs of circles

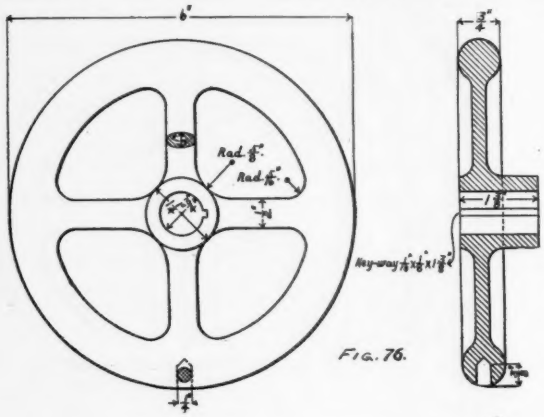


Fig. 76.

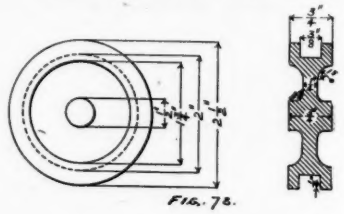


Fig. 78.

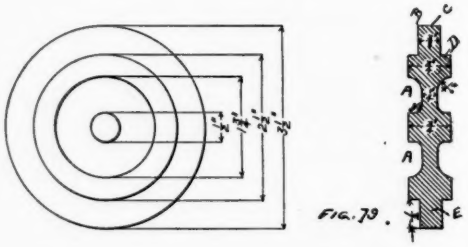


Fig. 79.

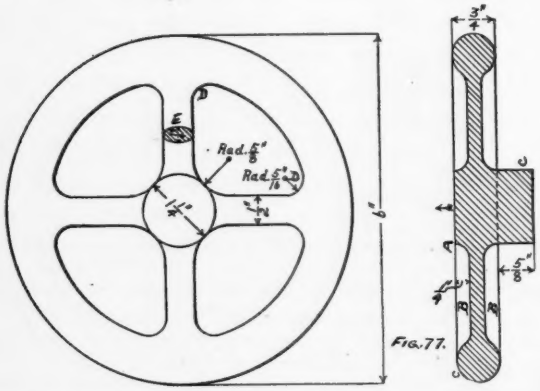


Fig. 77.

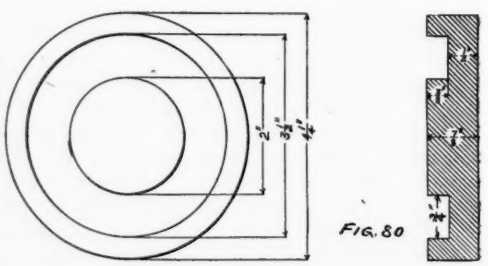


Fig. 80.

at *D* may be bored, preferably with a Forstner bit. This bit has no spur and therefore the stock—which is but ¼ in. thick—will not split so readily as it would if a bit with a spur were used. A small key-hole saw may be used for cutting away the remainder of the wood. The arms are to be round, as shown in the section at *E*, Fig. 77. This is done with a small half-round file. Care must be taken in filing the two arms having cross grain so as not to cause them to split. All holes should be bored before any extra material is removed. The filing is done after all surplus material is removed. The surfaces cut away should finally be sandpapered, and the pattern finished as usual. This pattern might have been made with inserted arms, as was done in the case of the small hand wheel described in the December number of AMATEUR WORK.

Fig. 78 shows the casting for a small wheel cut out at the rim to receive a small, round belt. This pattern requires a special sprue in molding, and the method of using this sprue will be taken up in a later article. The pattern, which is shown in Fig. 79, is to be turned first, and then the block is turned around so that the other half may be turned. Both sides of the pattern are alike and care must be taken to make all measurements the same on both sides. This pattern is molded so that the parting line between the cope and nowell comes at *B*, Fig. 79. A little draft will be necessary both on the surface *C* and at *D*. This pattern is much smaller than the one just described for the hand wheel, and trouble may be experienced when the block is turned around on the screw center for the turning of the second side, because of the running out of the block. If this trouble is experienced the block had better be chucked.

Fig. 80 shows the corebox which is used with the pattern shown in Fig. 79. The right end view is a section drawing made to show the shape of the body of the ring. A core made in this sort of a corebox is known as a ring core. It will be noticed that the core print, *E*, projects out from the pattern ¼ in. The width of the core itself is ⅝ in., showing that the casting is to have a recess of ¼ in to receive the belt. Care must be taken in turning the corebox on the screw center to have a little draft so that the core may be readily withdrawn from the box. The measurements must be exact. If the corebox were made a little too large, the core would not set down into the mold made by the pattern. For a pattern of this kind it is found desirable to use mahogany instead of pine, as the block is apt to warp after the first side has been turned up.

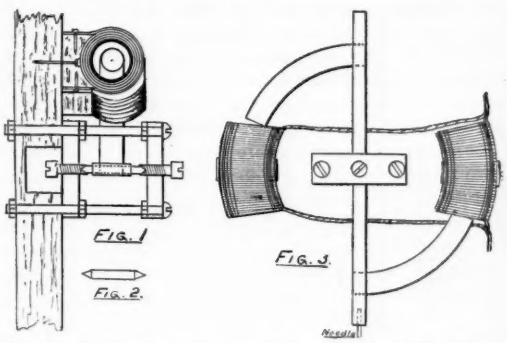
# AN EASILY MADE AM-METER.

OSCAR N. DAME.

Every amateur should possess an accurate amater for measuring battery current and general laboratory testing. While the high grade instruments for sale by apparatus dealers are beyond the means of most students, it is possible to construct an efficient instrument for a small sum. Much of the construction can be done with ordinary household tools, but there are a few portions of the meter which require absolute alignment, and which will give better satisfaction if fitted by an experienced hand. This instrument is to be used in a vertical position, presumably fastened to the wall near the work bench or test table.

Upon the true workings of the bearings depends the accuracy of the machine. The style of pivot is shown in Fig. 1. With this conical indentation cut smoothly and accurately in the end of a machine screw with a fine jewellers' drill, and a hardened staff constructed of a piece of old clock staff, as in Fig. 2, there should be little friction. If, however, the reader should desire jewelled accuracy, I would advise him to construct all of the instrument except the pivot portion, and then send his machine screws to a jewel setter, who will insert ordinary jewels for about fifty cents each. While the dollar spent for this professional assistance may add greatly to the accuracy, I believe for ordinary purposes it is just as well to construct without jewels, as I did my first one, and attend to the improvements afterwards, if it does not meet all requirements.

Procure a soft iron ring 4 in. in diameter, of ⅝ in. stock. Such a ring is sold at all hardware stores for hitching posts, etc. Procure a piece of brass 5 in. long ⅝ wide by 3-16 thick. Measure one half inch from one end and center for a ⅝ in. hole, to be drilled there. Center also 4 in. below and drill a second ⅝ hole. It will be seen that these holes apply to a 4 in., ⅝ ring. If the




amateur is unable to procure a 4 in., ⅝ ring, the measurement given for holes will have to be altered to conform. Next, by two cuts of the hack saw cut out about 1 in. of the ring. This will permit slipping the rings into the holes in the brass rod. Solder is then carefully applied to hold the ring in place. Find half

the distance between the inside edges of the ring and mark same on the brass rod. Here a $\frac{1}{8}$ hole is to be drilled where the staff is to be placed and fixed with solder.

Procure a piece of clock steel, $\frac{1}{8}$ stock and 1 in. long, and fashion as in Fig. 2. The ends should be hardened and polished. When this steel is soldered into the shaft there will be about $\frac{1}{8}$ of an inch of each end visible. For bearings use two 8-32 machine screws $\frac{1}{4}$ in. long. In the end of each drill smoothly to receive the end of the staff. For supports of this bearing take two strips of brass $\frac{1}{4} \times \frac{1}{2} \times 1\frac{1}{2}$. Holes are drilled near the ends and in the center of these pieces and, with machine screws and nuts to fit, a support exactly like the figure is constructed. If the screws are quite long they will serve to pass through the base board. Next, with a tape measure mark off four inches of the ring at top and bottom and cut off this portion. See Fig. 1. Place pendulum in bearings and adjust to swing easily.

The two solenoids are formed of paper, fiber or hard rubber and should be fully $\frac{3}{8}$ inside diameter and $1\frac{1}{4}$ long, smooth inside and bent to conform with the shape of the metal ring pieces which enter them. Each tube should be wound with four layers of No. 20 magnet wire. The tubes are then fastened to the baseboard, as in Fig. 3, by means of metal clips. Fig. 3 also shows the circuit connections. A small 1-16 in. hole is drilled in the lower end of the pendulum and a fine long steel needle inserted for a pointer. To grade this instrument accurately will require some experimenting. A step by step comparison with a standard instrument would be the best way, but with batteries of known voltage and amperage the instrument may be calibrated to meet all ordinary requirements by the insertion of variable resistances in one of the battery wires (thus increasing the resistance of this circuit).

Calculate by one of the formulas of ohms law: $\frac{E}{R} = C$

For instance: A new dry cell, as tested at the electrical stores, might show 1.4 volts and 7 amperes on short circuit.

Thus: $\frac{1.4}{7} = \frac{2}{10}$ ohms internal resistance.

Any resistauce inserted in the external curcuit will cut down the current. And from any standard wire table showing resistance of different gauges of wire per inch, one can prepare sufficient resistances to cut down the current to any desired degree. For example:—The resistance of our two coils is a very small part of an ohm and need not be reckoned with. With 1.4 volts and 2-10 ohms we have 7 amperes. By inserting 1 2-10 ohms additional resistance we have:

$$\frac{1.4}{1.2 + .2} = \frac{1.4}{1.4} = 1 \text{ ampere.}$$

# NOTES ON WIRELESS TEEGRAPHY.

L. T. KNIGHT.

## IV. Course of the Transmitted Wave and Frequency.

During the early experiments with telephone transmissions in the original installation between Boston and Providence, a distance of about 50 miles, an enormous battery supply was held in readiness for the first conversation, and it is said to the great surprise of all present in the room where the tests were made, the amount of voltage was cut down from 50 to that of two primary cells, and no harm to transmission resulted.

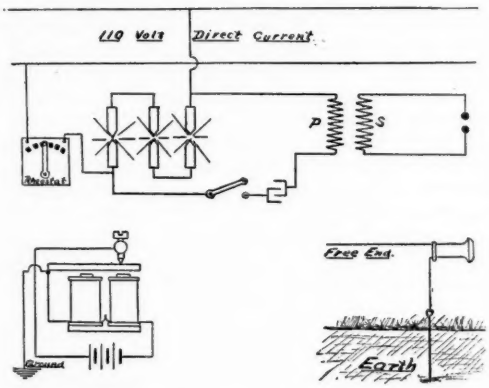
In the early Atlantic cable tests heavy battery soon gave way to weak battery because experts found the feebler currents more reliable. Now in the present era, with wireless telegraphy foremost in the mind of every transmission specialist, we find the different systems struggling for supremacy by the use of enormously high poles, ranging from 175 to 210 feet in height, and by transformed voltages reaching into six figures. Scores of systems have been patented at the patent offices of this and foreign countries, and in nearly every instance the systems have called for aerials stretching as far into the heavens as the skill of man will permit, following the theory that the effective part of the wire is at the upper end. And where single wires are used it is considered necessary to fit a huge wire capacity cage at the upper end, and the length of this aerial wire from instrument to peak is a factor in determining the wave length.

Presuming that the transmitted wave leaves the aerial at the peak, its course to the other station was construed to be in a straight line, and the expounding of this theory has filled chapter after chapter, and one of the recent books on the subject, in a full page illustration, scales out the course of Marconi's wonderful messages from Canada to Great Britain with dotted precision, explaining the curvature of the earth and the drop of many miles below the ocean's surface which the waves must have taken because of this curvature.

Those who have experimented exhaustively in this matter, find that a transmitted wave leaves the aerial wire perhaps at the peak, and perhaps a short distance from the peak, and its course to the receiving aerial is determined by atmospheric conditions and not by any B line from the top of a 180 foot pole to a 120 foot pole situated on a hill top. It is, therefore, worth prophe-

cying that the high poles will soon be a thing of the past and waves will be energized by moderately high voltage and extraordinary frequencies. And at the receiving end the coherer and wave detector of the present will be superseded by devices tuned to receive frequencies and not wave volume or wave length.

One of the best systems of generating alternating currents of high frequency is here illustrated. Its design is simple, and any amateur possessing a few electric light carbons and a condenser of the Leyden jar type, may produce frequencies beyond 10,000 per second. The ordinary 110 volt current is tapped as shown in the illustration. The choke coil has a variable resistance. The capacity of the condenser should be 10 M. F.




To increase the secondary frequency still further, one may construct a frequency coil out of two battery or other smooth jars, one being 4 in. in diameter and about 6 or 7 in. high, and the other 8 in. in diameter and the same height. The smaller jar is wound with one layer of No. 36 bare or covered magnet wire from an inch at the bottom to the top, and each turn must be separated from the adjoining turn fully 1-16 of an inch. A hole is made in the bottom of the jar, and the lower end of the wire is brought up through to the top where it pairs with the other end. On the larger jar is wound in turns ½ in. apart, one layer of flat, thin strip metal, preferably of good conductivity. These strips may be ½ in. wide. This strip circuit is the primary side of the frequency coil, and is connected to the secondary balls of the induction coil. The inner jar is thoroughly insulated from possible moisture by filling the larger jar with insulating oil.

Such a frequency coil may be constructed on a skeleton framework of glass rods, instead of the glass jars, and insulated in any size of jar. Good results can be obtained by using it in connection with a small induction coil operated by dry batteries.

The task of designing an efficient frequency recorder is a puzzling one and will, perhaps, take the form of a device resembling the telephone receiver, worn constantly by the operator, who will receive by ear, or it may take the form of a balance which will become operative when the proper frequency reaches it.

Few amateurs can fail to find amusement and profit in noting the effect of currents of just ordinary frequency sent into the earth from an ordinary doorbell or, what is better, a buzzer. The connections are shown in Fig. 2, and the telephone receiver is used to pick up the tone.

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In a review of the progress of aerial navigation, M. Octave Chanute says that the best shaped navigable balloon yet constructed was that which was made by MM. Krebbs and Renaud of the French War Department as long ago as 1885, and he thinks that this flying machine was superior in most respects, save that of motor equipment, to the well-known balloons of M. Santos Dumont, which have been built since. He also believes that better results than have hitherto been attained would have been reached by the Lebaudy airship had it not been destroyed; and the construction by the Lebaudys of another airship on the same line is therefore, an event of considerable interest. M. Chanute has no doubt that it is the improvement of the motor which is, and will be, the largest factor in the coming flying-machine, and this factor will apply with equal force to the airships of Santos Dumont, Lebaudy and Barton, or the aeroplanes of Prof. Langley or the Brothers Wright. In a general forecast of the flying-machine's future, he remarks: "The machines will eventually be fast, but they are not to be thought of as commercial carriers. To say nothing of the danger, the sizes must remain small and the passengers few, because the weight will for the same design, increase as the square. It is true that when higher speeds become safe it will require fewer square feet of surface to carry a man, and that the dimensions will actually decrease; but this will not be enough to carry much greater extraneous loads, such as a store of explosives or big guns to shoot them. The power required will always be great—say something like 1 h. p. to every hundred pounds of weight, and hence fuel cannot be carried for long single journeys. The North Pole and the interior of Sahara may preserve their secrets a while longer."

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Postmaster-General Wynne and Baron Moncheur, the Belgian minister, signed a parcels post treaty between the United States and Belgium on November 10. Under this treaty the parcels are restricted to four pounds and six ounces each and fifty dollars in value. It is the third parcels post treaty negotiated between this country and European countries, and the twenty-sixth with any government, most of the existing treaties being with South and Central America. The present treaty will go into effect February 1. If we can have such postal facilities with foreign countries, is it not about time for the same service at home?

# PHOTOGRAPHY.

## COLOR VALUES.

HARRY L. SHEPHERD.

Recognizing the fact, from the school of experience, that practical information, for the busy amateur on the subject of ortho-chromatic photography is hard to find, I hope in this article to introduce the subject to those who are ignorant of the vast possibilities of color sensitive plates and perhaps to aid others who are struggling with the same plates in a haphazard way.

In trying to make the matter *very* clear, I may leave myself open to criticism at certain points, but please remember the article is principally for those who wish to get an understanding of the subject without recourse to text books on chemistry and physics.

The first question naturally asked by those unacquainted with the subject is, "Are ortho- or iso- (as they are also called) chromatic plates hard to work?" Now, to set your minds at rest, let me say right here that they are just as easy to "work" as ordinary ones, the only difference being that you must use more care with your dark-room light.

A few words of explanation. The popular idea is that ortho plates give a better rendering of the "color value" of objects than ordinary plates. Now, to set your minds at rest, let me say right here that they are just as easy to "work" as ordinary ones, the only difference being that you must use more care with your dark-room light.

A few words of explanation. The popular idea is that ortho plates give a better rendering of the "color value" of objects than ordinary plates. Now, the term "color values" is to many, misleading. It is not the differences of hue in objects that these plates render more correctly, but rather the "relative brightness" of objects one with another without regard to their color. You must see that you cannot render colors in monochrome. White light, as perhaps you know, is composed really of seven colors, viz.: red, orange, yellow, green, blue, indigo and violet. This you can see for yourself by darkening a room and allowing a ray of sunlight to pass through a narrow slit in the window blind. Let this ray or beam of light fall on a white screen, say a piece of white blotting paper. Now in the path of the ray of light, near the screen, interpose a glass prism and you will get the band of colors, called the spectrum, in the order I have mentioned above. It is an experiment well worth trying.

Besides the visible spectrum two sets of invisible rays exist, one located beyond the violet, called the ultra-violet, the other beyond the red, called infra-red. The ultra-violet rays are those which affect all photographic plates most and are thus said to be "actinically powerful." The infra-red really has no effect.

Now, the trouble with ordinary plates is this: They are so powerfully, *i. e.*, quickly affected by the ultra-violet, violet and also blue rays, that the green, yellow, orange and red rays do not get time, as it were, to act or impress themselves on the plate. If we give sufficient exposure for the green to red rays, then the blue, etc., are greatly over-exposed.

Try to render blue sky, white clouds and green grass on an ordinary plate. In your print the blue will be rendered as white paper; at any rate, there will not be any distinction between the blue sky and white clouds, and the green grass will be rendered many tones too dark. The reason is that blue affects the plate more powerfully or quickly than the green, and so in the negative the "blue part" is very dense and the "green part" comparatively thin, when to the eye the green grass may be only a shade or two darker than the blue of the sky. To overcome this defect certain dyes are mixed with the plate emulsion, before coating the plates—sometimes ordinary plates are bathed in the dyes—and this gives us ortho- or iso-plates which, according to the dyes used, are made more sensitive to green, yellow, orange and red. This property is strongly increased when in conjunction with the ortho-plates we use a ray screen, also called ray filter, which is usually placed over the lens and which to a great or less degree, according to its depth of color, absorbs the ultra-violet, violet, indigo and blue rays, *i. e.*, holds them back, as it were, thus giving the others a chance to impress themselves on the plate. In fact, it acts as a "compensator," and of course increases the exposure, the increase depending on the depth of color of the ray screen.

All ray screens are for the purpose of absorbing or "holding back" the rays at the violet end of the spectrum. They are made of yellow tinted glass or cells filled with a weak solution of bichromate of potash, and are made light or dark to suit certain work. For ordinary work screens to increase the exposure from three to six times are all that are required. Ortho-plates, *i. e.*, the "fast" varieties, are equal in speed to all ordinary "fast" brands of regular plates. They can be used in snap-shot work just as any other plate, but under ordinary circumstances for snap-shot work they are not any better than the regular plates, as the

ultra violet rays affect them to too great a degree. If you possess a "fast" lens and say at snap-shot speed and stop f. 16. you get a properly exposed negative; then if you use a screen which increases the exposure four times and open your stop to f. 8, you may go ahead, and you will get the benefit of the ortho-chromatic quality of the plate. You see, you increase the exposure four times by using the screen, but with stop f. 8, you allow four times as much light to pas . Stop f. 8 is four times the area of stop f. 16.

If you wish to "catch" the clouds, use an ortho plate and ray screen, except, perhaps sometimes about sunset, when the yellow tint of the atmosphere acts itself as a screen.

In flower and fruit studies, in fact any place where we have to deal with colors, ortho-plates are a neces ity if correct results are required. In the case of flowers a ray screen is seldom necessary, except where blue and yellow are together, and then one to increase the normal exposure not more than six times is all that is necessary. If you use too dark a screen you are apt to reverse the color values in your subjects.

In fact, ortho plates should be used in flower and fruit studies, marine, autumn landscapes, clouds, interiors (where color has to be dealt with), portraiture, (subjects with golden hair), copying paintings and faded (yellow) photographs.

So, you see, their use ought to be pretty general.

I will now touch on their manipulation. Calculate your exposure as you would for an ordinary plate, *i. e.*, if your ortho-plate is of "fast" variety, such as Cramer Inst. Iso. If you use a ray screen which increases the exposure say four times, then give the plate four times the exposure you have calulated.

When handling in the dark room I use two thicknesses of orange tissue paper, and I do not allow any more light than necessary to fall on the plate at any stage. Now, don't imagine that you have to work almost in Egyptian darkness. Nothing of the kind; but use care and judgment. As ortho-plates are color sensitive, then they are more sensitive to the dark-room light than ordinary plates. During development I keep the developing tray covered with a piece of cardboard.

For developers, Pyro can't be beaten. The solution soon colors and protects the plate, and in the print you get "snap" that personally I can't get with other developers.

In conclusion, take my advice and buy a dozen Instaneous Iso-chromatic plates and a light ray screen to increase the exposure say four times (if the man you buy your screen from is not sure of the increase of exposure necessary you will have to experiment and find out), and expose them against a dozen ordinary plates of the brand you use. Try a flower study, such as pansies with yellow and blue in abundance, a couple of land scapes with clouds, an interior where you have to deal with color, etc., and if you work carefully and systematically your first dozen ortho-plates will convince you that in most cases they are far superior to ordinary plates and the "tales" you have heard of of their "hardness" of working is a myth.—*Western Camera Notes.*

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The prediction of Edward W. Parker, of the United States Geological Survey, of a coal famine in fifty years, is disputed by the officers of the Reading Coal Company, who say that their company alone can supply the world with anthracite for the next fifty years. They estimate that in the virgin basin of hard coal extending from Pottsville up the Schuylkill Valley toward Tamaqua there are 5,000,000,000 tons of anthracite. "It is true that the coal supply in the upper part of the region has reached its limit," they say, "and more and more the great southern basin, owned exclusively by the Reading Company, must be drawn upon to a greater extent, but it is also strictly true to say that within ten miles of the Reading Coal & Iron Company's headquarters in Pottsville there is as much hard coal as has ever been mined." It was in this unmined region that hard coal was discovered, and it was also in this region that the utility of hard coal for blast furnaces was first established. The shallow veins north of this region proved cheaper to operate, and as a consequence the big basin of the Reading Company has remained almost untouched. The coal in this basin lies much deeper than the veins operated at present by the company, and the expense of mining will be correspondingly greater. This will not be superlatively cheerful news to the consumer. He may console himself, of course, that he will be able to keep himself reasonably warm for the next fifty years, but the realization that he will have to pay more each year for the pleasure of keeping warm will more than offset the consolation.

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Later details show that the recent eruption of Mont Pelee was nothing out of the ordinary, and nothing of any great moment has occurred to the volcano since last October. Last year a great obelisk or needle was thrust out of the crater, to a height of a thousand feet. It suffered several subsidences, followed sometimes by new elevations, but finally collapsed or sank back into the funnel from which it had been forced in August of last year. Since then its place has been taken by a dome, and this dome has undergone similar changes in height, though on a lesser scale, to those exhibited by the obelisk. More than once the dome was blown out by eruptions, and during December last it sank about 90 feet. Since then, however, it has risen again, and now a new phenomena is making its appearance. The obelisk which disappeared a year ago, or else a new one, is being pushed up through the dome. It is being built up or thrust up slowly; but it has gained 100 feet in this year, and the mountain as a whole is recovering the height which subsidences took away from it in the winter.

# REFINEMENTS OF MECHANICAL SCIENCE.

AMBROSE SWASEY.

Abstract of the President's Address at the Dec. 1904, Meeting at New York of the American Society of Mechanical Engineers.

For the subject of my address I wish to speak of a few of those methods and mechanisms which have been developed and perfected to such a degree of refinement that they may be considered as almost beyond the practical, and yet were it not for such refinements they could not possibly be made to serve the utilitarian purposes which make them of such inestimable value to us all.

The division and the measurement of time is today, as it has been for ages, one of the most important of the subjects affecting the welfare of mankind, and as time has rolled on and there has been a better understanding of the laws governing the universe, nearer and nearer has been the approach to perfection in the working out of these difficult problems, but the limitations surrounding them have always kept their full solution somewhere in the future.

The diurnal revolution of the earth, which gives the solar day, and the revolution of the earth around the sun the solar year, are the arbitrary divisions of time marked off with the utmost precision by the celestial bodies; and while the length of the solar day has, from before the Christian Era, been fairly well defined, the length of the solar year was but approximately known until within a few hundred years.

The length of the year as counted by the Julian calendar, was too long by eleven minutes and fourteen seconds, and this error amounted to ten full days in the sixteen hundred years from the time the Julian calendar went into effect until the introduction of the Gregorian calendar.

A few years ago when visiting the Vatican Observatory, I was particularly interested in the Gregorian tower, which forms a part of the Vatican Library Building. After passing through a number of rooms which are used in connection with the observatory, when near the top of the tower I was taken into the spacious and beautiful calendar room, the walls of which are covered with paintings of the highest order, executed centuries ago, under the direction of Pope Gregory XIII. In the center of the room, and forming a part of the floor, there was a large marble slab on which was cut a fine line exactly in the true meridian, and upon the line was a special mark which indicated the altitude of the sun at noon of a certain day. On the south wall, near the top of the room, there was a small aperture through which the direct rays of the noon, projecting a bright spot on the meridian line.

All of this had been planned and executed by the astronomers in order that they might demonstrate the necessity of reforming the calendar, and when at noon on March 23, 1582, Pope Gregory saw that the altitude of the sun as shown by the beam of light was not for that particular day, but for the day ten days previous, he directed that ten days be stricken from the calendar, and that day should be March 11 instead of March 23. With such precision had the astronomers determined the true length of the year, that our present calendar with its intercalculations will continue on for twenty thousand years, with an error not to exceed a single day.

The line on the marble slab and the aperture through the wall of the calendar room were devices simple in the extreme, and in this day of instruments such a method would hardly be considered, yet they served their purposes admirably, and the placing of that line on the true meridian, with an accuracy never before attained, was considered one of the greatest scientific achievements of that age.

The sun-dial is not only earliest but the most interesting of all the numerous arrangements that have been devised for measuring the divisions of the day. Notwithstanding its limitations, it has been a subject which has attracted the brightest minds for ages. Recently a new dial has been invented by which the rays of the sun will indicate the true mean time for each day of the year, with an error not to exceed one minute.

The hour-glass, which came later, was considered a much more practical method, inasmuch as it could be used either day or night, and because its use was not confined to a particular location; however, as a timekeeper it was not satisfactory, even in those early days.

The clepsydra or water-clock, which is supposed to have been invented by the Greeks, was found to be a much better timekeeper than either the sun-dial or hour-glass, and it was a great step in advance toward the accurate measurement of time.

These water-clocks are to this day used extensively in the East, more especially in China. In the city of Canton there is a water-clock which has been running for eight hundred years, and at the present time is is the standard clock of the city.

This clock consists of four water jars, each having a capacity of eight or ten gallons. The jars are placed one above the other in the form of a terrace, the three upper ones being provided with a small orifice near the bottom through which the water drops into the jar next below, and so on from one to the other until the water reaches the lowest or registering jar. In this there is a float to which is attached an upright having graduations for the hours and parts of hours, and as the water rises the time can be determined by noting the height of the float in relation to the cross-bar at the top

of the jar.

In this improved form of water-clock the variation in the flow of water due to the difference in height is overcome by having a series of jars, the outlet of the upper being so graduated that there is but little variation in the height of water in the second jar, and in the third the height remains practically uniform, thus ensuring a constant head for the water which drops into the registering jar. At the beginning of each day the water is taken from below and carried up a flight of steps to the top.

That such an arrangement has some elements favorable to the accurate measurements of time, there can be no donbt. It certainly has the element of simplicity, and notwithstanding its long service the only wear noticeable was confined to the steps leading to the upper jar.

Clocks of the present type, although used as far back as the twelfth century and possibly earlier, were but fair timekeepers until several centuries later. Those which the astronomers used in their observatories at the end of the fifteenth century were so unreliable that modified forms of the clepsydras of the ancients were used, and as they did not prove satisfactory, most of the observations were made without the use of clocks.

Galileo's beautiful discovery of the isochronism of the pendulum from the swinging chandelier in the church at Pisa was of great value in many respects, but in none more so that in its application to the measurement of time.

Soon after this great discovery the English clock-maker, Graham, invented the mercurial pendulum, by which the variation in its length caused the difference in temperature was fully compensated, and some years later Harrison, another English clock-maker, invented a compensating pendulum, which consisted of a series of metal bars having different coefficients of expansion—so that two hundred years ago, as it is today, the pendulum was the nearest perfect of all the devices that have been employed for governing or controlling the motions of a clock mechanism.

Every part of the clock, down to the minutest detail has been the subject of study and improvement, and they are made and adjusted with such precision and delicacy in testing them, the question is within how small a fraction of a second they will run. Not content with their marvelous performance when under normal conditions, some of the finest astronomical clocks are surrounded by glass or metal cases in which a partial vacuum is maintained, and in order that the case may not be opened or disturbed, the winding is done automatically by means of electricity; the frequency of the winding in some cases being as often as once every minute. These clocks are set up in especially constructed rooms or underground vaults where they are free from jar or vibration, where the temperature and barometric conditions remain practically constant, and where every possible precaution is taken to further minimize the errors of the running rate.

A clock in the observatory at Berlin has run for several months under these favorable conditions, with a rate having a mean error of but fifteen one-thousandth of a second per day and a maximum error of thirty one-thousandths of a second per day.

From the time of the invention of Peter Hele, in 1477, of the "Nuremburg animated egg" or "pocket-clock," which required winding twice a day, and varied an hour and one-half in the same length of time, the development of the watch has kept pace with the "mother clock" and followed closely to it in time-keeping qualities.

The larger watch or ship chronometer, with its escapement so delicately made and adjusted that it must always be kept in the same position, was greatly improved through the efforts of the British government in 1714 by offering rewards of ten, fifteen and twenty thousand pounds to any who should make chronometers that would run so accurately that the longitude of a ship at sea could be determined within fifty, forty and thirty miles, and Harrison, the inventor of the compensating pendulum and the compensating balance, which is now used in watches, succeeded in making a chronometer which, after being tested on a long voyage, was found to run so closely that the position of the ship was determined within eighteen miles, and he was therefore paid the full award of twenty thousand pounds. That historic chronometer, which marked a new era in navigation, is now numbered among the treasures of the Greenwich observatory. Modern ships are equipped with chronometers so accurate and so reliable, and with sextants of such precision that navigators can determine their position in latitude and longitude within a few miles.

The perfection attained in the measurement of time, which is of such great practical value in nearly every sphere of life, would not have been possible were it not for the even greater refinements that have characterized the methods and instruments used by the astronomer in determining the length of the day and of the year, which are the fundamental standards of time.

That the repulsive and even dangerous spider has plenty of enemies among the human family there can be no doubt, yet if the value of the contributions which it has made to the cause of science were generally known, it would surely have a greater number of friends than at present, and most certainly the astronomer will say naught against it, for after the experience of many years he has found that the spider furnishes the only thread which can be successfully used in the instruments for carrying on his work.

The spider lines mostly used are from one-fifth to one-seventh of a thousandth of an inch in diameter, and in addition to their strength and elasticity they have the peculiar property of withstanding great changes of temperature, and often when measuring the sun spots, although the heat is so intense as to crack

the lenses of the micrometer eye-piece, yet the spider lines are not in the least injured.

The threads of the silkworm, although of great value as a commercial product, are so coarse and rough compared with the silk of the spider that they can not be used in such instruments.

Platinum wires are made sufficiently fine, and make most excellent cross wires for instruments where low magnifying powers are used, yet as the power increases they become rough and imperfect.

Spider lines, although of but a fraction of a thousandth of an inch in diameter, are made up of several thousands of microscopic streams of fluid, which unite and form a single line, and it is because of this that they remain true and round under the highest magnifying power.

An instance of the durability of the spider lines is found in the Alleghany Observatory, where the same set of lines in the micrometer of the transit instrument has been in use since 1859.

The placing of the spider lines in the micrometer is a work of great delicacy, and in some micrometers there are as many as thirty which form a reticule, with lines two one-thousandths of an inch apart, and parallel with each other under the highest magnifying power.

## BOOKS RECEIVED.

CYCLOPEDIA OF APPLIED ELECTRICITY. Various authors. 5 Volumes. 2,200 pp. 2,000 illustrations, 9½ x 6½ in. Half Morocco, $30.00. [Introductory Price. $15.] American School of Correspondence, Chicago, Ill.

It is impossible, in the limited space available for a review of these extensive volumes, to give more than a brief outline of the wide range of topics treated therein, but a most hasty examination reveals at once the excellent and careful manner in which the seventeen different authors have presented the several subjects upon which they have written. In addition, twenty-seven eminent authorities have been consulted during the preparation of the matter, thus giving to the various sections a completeness and up-to-date character rarely to be found in a work of this kind. To the student of electricity, who must of necessity have a working knowledge of the commercial applications as well as theoretical principles of the subject, these volumes will be of the greatest value, as they supply in convenient form a store of knowledge to be obtained otherwise only by the purchase of numerous books at a cost far greater than the moderate sum at which these volumes are offered.

In Vol. I. are found the sections: Elements of Electricity, The Electric current, Electrical Measurements, Electric Wiring, The Electric Telegraph, Wireless Telegraph, The Telautograph, Insulators and Electric Welding.

In Vol. II.:—Theory of Dynamo-Electric Machinery, Direct Current Dynamos, Types of Dynamos, Electric Machinery, Direct Current Motors, Electric Motors in Machine Shop Service, and Storage Batteries.

In Vol. III.—Electric Lighting, Shop Lighting, Electric Machinery, Power Stations, Central Station Development, and Geographical Method of Recording Data for Boiler Trials.

In Vol. IV.:—The Alternator, Commercial Types of Alternators, Synchronous Motors, The Transformer, Rotary Converter, Induction Motor, Switchboard and Station Appliances, Power Transmission and Mercury Vapor Converter.

In Vol. V.:—Telephone Instruments, Telephone Lines, Telephone Exchanges, Common Battery Systems, Telephone Operation, Telephone Systems, Telephone Maintenance, Automatic Telephone, Wireless Telephone, and Index.

In the above it will be noted that the more recent developments of the art receive due attention, while the older and familiar phases are presented with the completeness and accuracy possible only to the present day writers. The progress in electrical invention has been so rapid and varied during the last decade that single text-books can no longer contain other than the briefest presentation of principles; and a work of the size and extent of that above mentioned is necessary to any one who would study with that thoroughness which would make his work of practical value. For that reason, as well as many others, this cyclepedia is warmly commended to the readers of this magazine.

METAL WORKING. Edited by Paul N. Hasluck. 760 pp. 9 x 6½ in. 2,200 Illustrations. $4.00. Cassell & Co., Ltd. New Yokr. Supplied by AMATEUR WORK.

As indicated by the title, mental working in all its branches is quite fully covered within the limits of this rather massive volume. After holding it long enough to obtain a comprehensive idea of its contents, one is inclined to wish the publishers had seen fit to divide it into two or three parts, but this objection will be quickly forgotten in the interest which its contents will have to the mechanically inclined reader, be he amateur or professional. The chapter on foundry work includes the commonly used metals and alloys, the processes of melting and pouring and moulding the patterns for casting; smith's work includes sheet and bar metal work, as well as decorative iron work; forging and working sheet metal having additional chapters which treat these subjects quite exhaustively. Chipping, filing, polishing, annealing, hardening and tempering are fully dealt with, as as are drilling and boring. Taps, threads and dies are followed by soldering, brazing and rivetting. Repousse work, oriental decorative brass work, finishing, lacquering and coloring brass, gold and silver working, and wire work are also given special chapters.

Lathes and lathe work include both speed and screw cutting lathe work, the uses of hand tools and lathe

attachments, as well as the uses of tools for measuring and testing metal work. A chapter on metal spinning is of special interest. The building of a lathe, skeleton clock, horizontal and vertical steam engines, boiler, gasoline motor, water motor, dynamo, microscope and telescope, supply varied applications of the information contained in previous chapters. A very complete index facilitates reference to the contents, which should be of interest to many readers of this magazine. As a book for public libraries it would have a special field of usefulness.

ELEMENTARY COURSE IN MECHANICAL DRAWING. Arthur W. Chase, B. S. Part I., 189 pp. 8½ x 6¾. 97 Illustrations. Cloth, $1.50.

That the author has pronounced ideas relative to the method of teaching mechanical drawing in a manual training high school, is evident from the general make-up of the contents. To prevent copying, which is objected to by the author, no plate showing a finished sheet of geometrical or projection problems has been included. Other departures from conventional methods are noted which, with the one above mentioned will be strongly questioned by teachers of experience, as well as by drafting room managers. The previous work done by the pupil, or absence of any previous instruction, will have an important bearing on the adaptability of this book. As a desk book for teachers it contains much of decided value, and is a very useful help in making up class work.

ELECTRICAL ENGINEERING FOR STUDENTS. S. R. Bottone, 153 pp. 7¼ x 4¾. 49 Illustrations. Cloth, 80 cents. Gilbert Pitman, London. Supplied by AMATEUR WORK.

The author is so well known as an able writer on electrical subjects that no words of commendation are needed to assure those interested in the subject that this book presents the elemental principles in a clear and attractive manner, together with considerable constructural work by means of which the instruction given can be more fully understood. An excellent work for beginners.

ORNAMENTAL TURNING. J. H. Evans. Vol. I. 172 pp. 7¼ x 5. 120 Illustrations. Cloth, $1.25. Gilbert Pitman, London. Supplied b AMATEUR WORK.

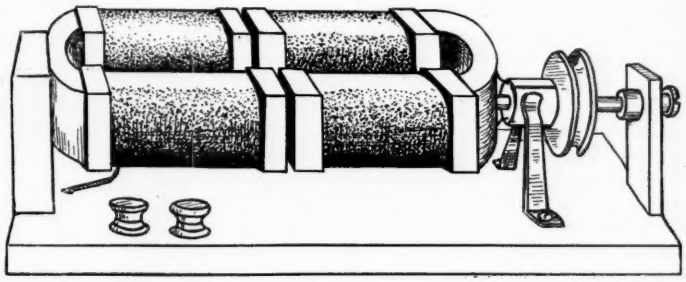
The author is a well-known authority and writer upon this subject, and this volume, the first of three, presents a well arranged and systematic course in ornamental turning. The text is fittingly supplemented by suitable illustrations, making the book invaluable to any one interested in posting up on this subject, as well as the best guide obtainable to one who would learn without a teacher.

# A SIMPLE ELECTRIC MOTOR.

ALBERT G. WARREN.

The accompanying illustration shows a simple type of electro-motor suitable for driving small models, boats and cars or for rotating color discs. Under no circumstances must it be expected to do work requiring more power than that derived from the ordinary types sold for about a dollar, yet if well made it will run well on one cell of any kind of battery, and at a high speed when more cells are added.

The magnets may be cast in soft iron from a wooden pattern, or forged into shape from a strip of iron ¼ in. thick and ¾ in. to 1 in. wide. Each magnet is 2½ in. long, and the space between poles is 1½ in. One of the magnets is to be fastened permanently to the wooden surport, and the other is fastened to a shaft of ⅛ in. steel. This shaft fits evenly into ⅛ holes drilled into



small machine screws which serve for bearings. One screw is shown in the illustration, and the second projects through the center of the fixed magnet. A two-part commutator, of a design so familiar to all amateurs that it need not be described here, is affixed to the shaft, as is also a small wooden pulley turned to any size convenient for the maker. The two magnets are wound each to have north and south poles like any horseshoe magnet. The wire should be about No. 22.

The rotating magnet is placed in position before the fixed magnet with just enough space between the poles so as not to interfere when in motion.

One of the ends of the wire coming from the fixed magnet goes to a battery binding post. The other is carried to one of the brushes. The other brush is connected the remaining battery terminal. Each of the revolvin magnet terminals is connected with a segment of the commutator. All bearings should be well oiled and the shaft adjusted so as to turn freely.

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Renew your subscription before you forget it.

## CORRESPONDENCE.

No. 85. So. NORWALK, CONN., Jan. 23, '05.

Will you kindly answer the following questions relative to the battery described in the July, '03, number of AMATEUR WORK:

1. The diameter of the tin cans?

2. If cans were used 5 in. diameter and 10 in. high, what would be the correct dimensions for the wire gauze cylinder?

3. Can wire window screen netting be used in place of the 20-mesh gauze, as specified?

4. Can kerosene be used in place of the paraffine oil?

5. Should both the solution and oil be poured in the cylinder and on the filings?

6. What is the ampere hour capacity? F. B. H.

1. As mentioned in the description referred to, any tin can having lapped joints can be used; those with soldered joints will not answer, as the potash solution will attack the solder and leaks will soon follow. Cans used for preserved tomatoes will answer and are easily obtainable.

2. The gauze cylinder could be made about 2 in. diameter and 9 in. high. The purpose of the gauze cylinder is simply to retain the filings in place and prevent them from coming in contact with the zinc.

3. If window screen netting is used any paint should first be burned off and the filings will have to be screened, and none used that pass through the screen. A larger quantity of chips will be needed from which to get enough of the required size after screening.

4. Kerosene oil will not answer, and as paraffine oil is not expensive and is easily obtained of oil dealers, it should certainly be used.

5. The solution is poured into the cylinder before placing the zinc in position; it will fill any space around the filings and within the cylinder. The oil is then poured in and is used to prevent air from reaching the solution, potash having a great affinity for the moisture in the air as well as the oxygen.

6. Having had no personal experience with this cell would request any reader who has to give his experience in this matter.

No. 85 CLARKESVILLE, GA., Jan. 17, '05,

Will you please tell me of the process by which I can make a cell of dry battery stronger after it has become too weak to use? S. C. K.

An exhausted dry battery may be partially revived by sending a current of low voltage through same in reverse direction from the discharge, or by punching a few holes through the pitch used to seal it at the top, and putting in a solution of sal-amoniac and water or salt in water. Ordinarily, however, it is more satisfactory to get a new cell. Another way is to punch holes in the sides and put cell into an ordinary glass preserve jar and fill up with the sal-amoniac solution, thus converting it into a wet battery.

No. 87. BARRE, Vt., Jan. 11, '05.

What is the voltage of the Edison-Laland battery, type V.? Can anyone cast the zinc himself? E. N.

The E. M. F. of the Edison primary battery, type V., is .75 volt. It is made in two sizes, one giving 150 and the other 300 ampere hours. The zincs can easily be cast in wooden molds or in sand, but the oxide of copper cakes can only be made with suitable machinery, as a very heavy pressure is required to form them.

No. 88. CLEVELAND, OHIO, Jan. 12, '05.

Will you please give directions in your valuable magazine for making an induction coil which will give a good 12-in spark on a 20-volt current through the primary winding? E. A. H.

We quite frequently receive requests for descriptions for making large coils, but find that when the writer learns the cost of materials and the amount of work involved in the making, the desire is satisfied with a coil of much smaller dimensions. As there is, however, a demand for a coil of fair size, to be used in X-ray experiments in connection with a high-frequency coil, we are having prepared a description of an induction coil to give an 8-in. spark, to be followed by a description of a high-frequency coil of a suitable size to work with it. The combination will be adequate to do excellent X-ray and other coil experimental work, and is recommended as being an excellent size for ambitious amateurs to attempt.

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Dr. Haanel, Dominion Superintendent of Mines, who recently went to Europe to investigate methods of electrical treatment of ores, has received samples of gray, white and mottled pig iron, all having been reduced from the ore direct by the aid of an electrical furnace. Samples of castings made direct from the furnace are on exhibition, and are said to be of excellent quality. The gray pig is a superior quality of foundry iron, and can also be used for conversion into steel by the acid process.

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An exhibit at the recent meeting of the Society of German Plumbers which attracted considerable attention was that showing an invention of Chemist Blau, of Augsburg, for the manufacture of fluid gas from the residuum of petroleum and heavy mineral oils. The inventor says this gas may be manufactured very cheaply where there is an abundance of petroleum, and that it may be transported from one place to another in cylinders as easily as carbonic acid gas. The gas may be used for lighting churches, halls and detached buildings, and small tanks may be used in lighting automobiles. The Blau gas makes a very brilliant light for street lighting, and is very difficult to explode.

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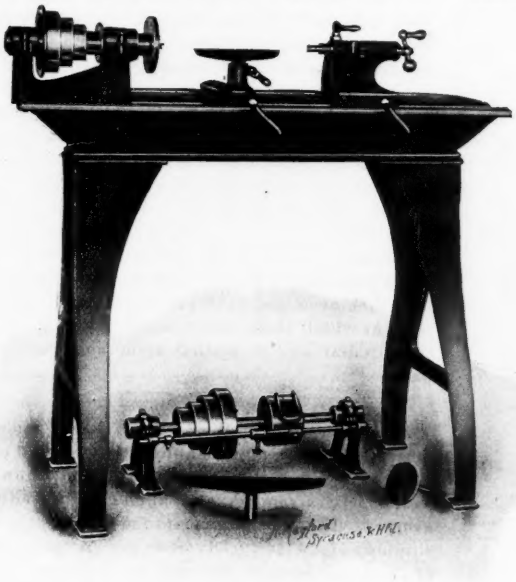
Secure useful presents by getting subscriptions for AMATEUR WORK.

# TRADE NOTES.

The accompanying cut shows the 10 in. "Star" wood turning lathe of a new design which has just been placed on the market. This lathe is admirably suited for use in manual training schools, as it contains many desirable features for such work, and is also commended to wood turners in general. The rated swing of the lathe is 10 in., but it has an actual swing of 11 in. over ways, and 7 in. over hand rest.

The head stock is of the web pattern, strong and solid, has a hollow spindle (with 17-32 in. holes) made from a crucible steel forging, and runs in large phosphor bronze bearings which are dust-proof and self-oiling, and will run at a high speed for a very long time without attention. The spindle is ground true and the bearings hand scraped to an accurate fit. The cone pulley has four steps, is turned inside as well as outside, and is in perfect balance for high speeds.



The tail stock is the curved or cut-under pattern, has a long bearing on the ways, and is firmly locked to the bed by a convenient lever which is attached and always in place, no wrench required. The tail stock spindle is locked by an improved locking device. The hand rest has long and short T-rests. The rest socket and saddle are locked to the bed by a cam locking device, and the T-rest is held in socket by a friction clamp (doing away with the objectionable set screw commonly used; both are operated by levers attached and always in place. No wrenches are required, therefore, for either the tail stock or rest saddle and socket.

The bed is broad and deep, and being thoroughly braced by cross webs is very stiff and rigid, and at present is made in two lengths, four and five feet long. The front way is flat and the back way is V-shaped (same as inside ways of the "Star" screw-cutting engine lathe). A convenient shelf is secured to the back of bed for reception of tools, etc. The countershaft has self-oiling and self-aligning shaft bearings, four step cone, and tight and loose pulleys; the loose pulley has a self-closing oil cup. Face plate, screw chuck, cup and spur centers are furnished with each lathe and, when desired, a slide rest for metal turning will be furnished at an additional price.

This lathe is manufactured by the Senaca Falls M'fg. Company, 103 Water Street, Senaca Falls, N. Y., U. S. A., makers of the well known "Star" screw-cutting engine lathes for foot or power, and the company will be pleased to send on request catalogue describing their complete line.

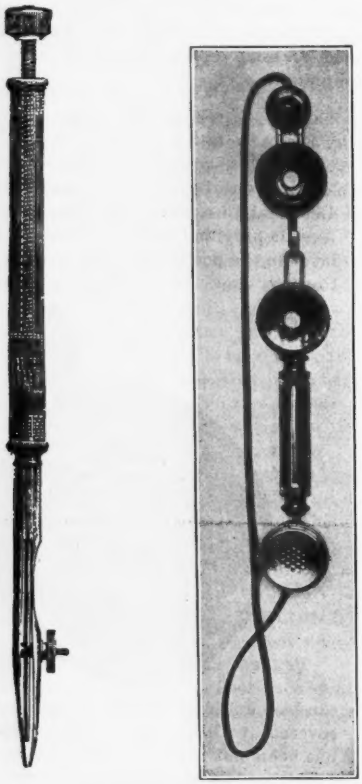
A new battery switch is now being placed on the market by the Atwater Kent M'fg. Works, Philadelphia. This switch is intended to be convenient and durable, and is designed after larger electrical apparatus. The handle end of the lever is provided with notches to keep the lever in the position in which it is intended to stay, and the handle is substantial and

can be manipulated easily when the hand is covered by a heavy glove. The locking device has been omitted on this switch, as such devices are known to be ineffective, and the owner is often annoyed by mislaying or losing the removable part.

Another convenient feature is that all connections are made after the switch has been mounted on the dash, and then the whole is covered by a name plate. This avoids bending the wires after the connections are made, in order to screw the switch into place, and the possibility of a poor connection. Whenever necessary to examine the connections the name plate may be easily and quickly removed for that purpose. It is of excellent design and substantially made; all of the brass parts are made of heavy metal, and the only holes that are tapped in the insulating part are

bushed with brass. The list price is $2.00 each. For sale by leading dealers in automobile supplies, or forwarded upon receipt of price by the manufacturers.

The fountain ruling pen here illustrated has been designed to overcome the drawbacks peculiar to such pens hitherto constructed, and from personal experience we can say it has proved to be a perfect success. Its outer appearance is that of an ordinary ruling pen; the hollow German silver handle, milled on the outside, serves as a reservoir for the ink; screwed to one of its ends is a fine capillary feeding tube, which extends between the blades of the pen proper. The latter is of finest quality and made of the best English steel. A German silver piston-rod acting screw-like from the other end of the handle effects a drawing in and expelling of the ink into or from the reservoir handle.



As the ink is drawn up in the reservoir handle, held there and expelled from it by pneumatic force it is impossible to "drop" ink while the pen is in use or when it is carried in the pocket, and the feeder is not liable to become clogged easily.

To fill the pen, the pen proper is pulled off the handle, thereby exposing the capillary feeding tube; the latter is immersed in the ink and by turning the milled head of the piston-rod to the left, the ink is drawn up in the reservoir handle. After replacing the pen on the latter, it is charged with ink by slowly rotating the piston-rod to the right. The pen is then ready for use. Should any ink be left in the pen proper after use, the same can be drawn back into the reservoir by turning piston-rod to the left. If the feeding tube should become clogged with ink, a steel pricker, furnished with each pen, serves to clean it. It can be obtained from Kolesch & Co., 138 Fulton Street, New York.

The "Echophone" is the name given to a new telephone here illustrated, which is manufactured by The Ericsson Telephone Co., 296 Broadway, New York City. It is specially adapted to private line use, and possesses several novel features which will be found to add greatly to its value. One of these is the adaptability with which any electric bell circuit can be changed to a telephone circuit by simply replacing the push button with a new one having terminals for connecting in the telephone. This method of connection enables a single telephone to be used at several stations, and enlarges the amount of service which can be secured with two or more instruments. The expense of equipping a residence, factory or store with these instruments is less than would be the case with stationary instruments. Full directions for installing are furnished with each set of instruments, and anyone without experience would have no difficulty in securing satisfactory service. The workmanship is of the well-known excellence of this company, the wonder being how such excellent work and finish can be given at the price at which these instruments are sold. A descriptive circular will be mailed upon request to the company.

The Fitchburg File Works have lately removed to a new and much larger establishment located at South Fitchburg. A visit to the new quarters shows a most excellently arranged and appointed building, with every facility for the manufacturing, packing and shipping of a wide variety of work. A spur track gives direct access to to the factory, so that material can be received and goods shipped without teaming, which in this industry is a most important feature. The additional facilities now at hand will undoubtdly result in a further increase in the rapidly growing business of this firm, and which the excellent quality of their files and hack saws most certainly entitles them.

The rapid acting vise manufactured by Abernathy Vise & Tool Co., Chicago, Ill., is just the vise for amateurs, as well as being specially adapted to the needs of manual training schools. It has a very quick yet positive action, is simple and strong in construction, has ample capacity, with no parts liable to break or wear out and, what is of equal importance, is sold at a price placing it within the reach of all.